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ABSTRACT

The use of computers in classrooms to support and extend instruction is a topic which is being discussed in major educational forums across the United States. Until a few years ago, computer use in schools was the exclusive domain of the mathematics department. Other content areas have now found ways to use computers to enhance their instruction. The purpose of this guide is to give teachers and supervisors a working knowledge of various approaches to enhance pupil learning. It demonstrates some of the many ways in which science departments can use microcomputers to assist teachers in teaching biology. Computers can be used to enhance the learning process by assisting students in recording and categorizing data, formulating conclusions, and conducting experiments. There are 122 activities in this guide. Each activity includes objectives, materials, motivators, development of the lesson, summary, and homework. Some are accompanied by worksheets. Also included is a discussion of classroom management techniques and (in the appendices) a glossary, a diskette care guide, information about copying public domain software, a list of software used in this guide, and a list of five additional school district resource centers in the Greater New York Area. (CW)

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NEW YORK CITY BOARD OF EDUCATION

OFFICE OF TECHNOLOGY
DIVISION OF CURRICULUM AND INSTRUCTION

COMPUTERS IN THE BIOLOGY CLASSROOM

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Foreword

The use of computers in classrooms to support and extend instruction is a topic which is being discussed in major educational forums across the country. Until a few years ago, computer use in schools was the exclusive domain of mathematics departments. Now, however, other content area departments have found ways to use computers to enhance the teaching of their subjects.

This guide demonstrates the many ways in which science departments can use microcomputers to assist teachers in teaching biology. Computers can be used to enhance the learning process by assisting students in recording and categorizing data, formulating conclusions and conducting experiments. We are confident that this new technology will extend student learning in ways not possible before.

We hope that the suggestions and materials included in this guide will demonstrate and support the range of uses of the computer in biology classes.

Charlotte Frank

Charlotte Frank, Executive Director
Division of Curriculum and Instruction

The use of computers in the classroom has become more prevalent during the last few years. Through this use we have developed a knowledge of their functions and a better vision of their potential. We encourage our colleagues to freely experiment and attempt new approaches. Only with all of us working in concert, can we fulfill our vision for an effective integration of school technology into all subject areas. From these beginnings, we will nurture the critical thinking and practical skills our students will need to succeed in the information age. If children are not comfortable with computers, they will be as unprepared for the future as an adult who cannot read or write.

The purpose of this guide is to give teachers and supervisors a working knowledge of various approaches to enhance student learning. Our guides are intended to be open ended and flexible in nature. As a 1920 car is not efficient by 1980 standards, outmoded computer education ideas of the seventies have been replaced by the new visions of the eighties. Classroom use of technology has doubled and redoubled in the past few years. Teachers are continually devising new ideas for the use of this technology.

Feel free to write to me directly with your comments and suggestions concerning this curriculum guide, so that we may improve and update it to meet your needs.

Irwin Kaufman

Irwin Kaufman, Director
Office of Technology

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Introduction

This book is designed to serve as a resource guide for teachers of biology. It is intended that this guide be used as a supplement to curriculum materials already available from the New York State Education Department and the Division of Curriculum and Instruction of the New York City Board of Education.

Each of the topics in this guide represents an approach to the use of computers as an enhancement to regular biology instruction. It is expected that teachers will "pick and choose" from among the various methods and approaches which are offered. In that sense, the book is a "sampler" of possible teaching techniques. Some topics may take one period to complete, others may require two or three class periods.

In no way is this book meant to represent a guide for an entire biology course but rather a collection of possible alternative methods of teaching individual biology topics.

Software which is named has been found suitable for the stated purposes. There may be other programs which will accomplish the same goals as those which have been named in this guide.

Present plans call for the development of similar enhancement guides for other subject areas. We welcome your suggestions for future direction.

Preface: Why Computers?

"Be not the first by whom the new are tried,
Nor yet the last to lay the old aside."

Nothing could give us better advice concerning the integration of computers into traditional teaching methods than Pope's couplet from "An Essay on Criticism." In embracing the computer, we certainly run the risk of being "the first," of rushing to rely too much on a machine's ability to teach and review. And yet, given the power of the personal computer to educate, we run an equal risk of being "the last " of resisting too much and relying too little on its abilities as a teaching aid and, therefore, losing, and causing our students to lose, the help computers can give classroom instruction.

What are the computer's strengths? Even a short list must include these points:

1. Classroom computers allow students to work individually, and yet together, on synchronized exercises.

2. Computers require each student to focus attention narrowly; for many students they insure a closer understanding of the day's work.

3. Computers allow a greater immediacy of individual student response for a greater number of students.

4. Computers give students immediate feedback during the exercise phase of a lesson.

5. Computers afford students the opportunity to work at their own pace, rather than at the pace of an imaginary class median.

6. Computers give each student a more thorough contact with the subject matter as an individual or as part of a small group.

7. Computers afford absentees a far greater opportunity to catch up on missed work without disrupting the flow of classroom instruction.

8. Computers allow teachers to make more efficient use of their classroom time as compared with more traditional question and answer lessons.

9. Computers encourage student response in a nonjudgmental way, thus making the sometimes groping experience of learning less intimidating for students who are not always comfortable in a classroom setting. Computers never get tired of or exasperated with a demand for countless repetitions of the same instruction.

10. Finally, and, perhaps, most important, the computer has an intrinsic motivational quality that increases student interest, concentration, and retention; we cannot ignore the appeal working with computers has for today's students.

Every experienced teacher will recognize that, except for point 10, none of these points is new; in fact, they have been part of good teaching since time immemorial. And that recognition indicates an important point about the computer and the classroom. The use of the computer is not, strictly speaking, something revolutionary in education, but something evolutionary instead. It enhances, rather than replaces, those methods of teaching that have traditionally been recognized as the most effective. Its instructional function is not something entirely new, and, consequently, something to be looked upon with suspicion, but something old done in a new and, often, more effective way.

Classroom Management Procedures

Thirty-six students working independently at 16 or more computer stations can easily lead to an almost chaotic confusion during the computer lab period, particularly if finding and distributing each student's working diskette takes too much time at the start. In addition, your ability to retrieve the performance information the program may record for each student depends upon carefully organizing the distribution and collection of the diskettes from the start. For these reasons, and a host of others, it is a good idea to think of classroom management procedures long before the computer lab period actually takes place, and to structure both the computer period and the computer room in ways that will make the computer period run smoothly and effectively.

In an ideal world each of your students would be able to work independently at a computer workstation, and that situation may exist in some classrooms at some times during the year. But most classes consist of 30 or more students and most computer labs of 16 or fewer workstations; the large number of workstations and the larger number of students requires careful record keeping and classroom management. Students must work in a highly structured environment in the lab or they will accomplish much less than expected.

The following outline of suggested procedures will help you create a structured computer lab. After a few periods in the lab, you'll be able to refine the procedures to better suit your own needs.

I. Before the computer lab period.

1. If you are not familiar with the computers in your school, or not entirely comfortable with them, try to spend some time working with them on your own before you guide your students in using them.

   Your uncertainty or uneasiness about computers may leave you at a loss at some point in your lesson or be transmitted to those of your students who also feel intimidated by the machine. In either case, it will have a negative effect on your lesson.

2. Preview the software you intend to use thoroughly. Learn what it does and how it works. Find out what background information your students will need to run the program -- for example, what vocabulary they will have to know. Once 16 groups of students start working and, presumably, asking questions, it will be impossible to decipher anything about the program that you, and they, may find confusing.

3. Number each workstation in the computer lab clearly, so that you and the students can see the numbers easily.

   If it isn't possible to copy one student data diskette for each member of the class, you can use one diskette at each workstation. However, the advantages of individual student data diskettes outweigh the disadvantages, and by a wide margin. Blank diskettes are relatively inexpensive, particularly when they are ordered in large quantities, and you will be able to use them year after year, virtually forever, simply by recopying the original data diskette over them whenever a class completes the program.

In addition, providing each student with a diskette will prevent certain student generated errors from occurring and make classroom management and student evaluation much easier for you. Refer to the Appendix section of this book entitled "Software Duplication Guidelines" for copying instructions and for information about obtaining diskettes through a Bureau of Supplies contract.

4. Label each diskette to coincide with one of the workstations -- i.e., diskette number 14 must always be used at workstation 14. (Of course, any diskette will work at any station, but for classroom management purposes follow this rule.)

5. Divide your class into workstation groups of two, three, or four students, as needed. Look over the student combinations carefully before making final assignments. If you don't feel that a particular combination of students will work well together for an extended period of time, don't allow them to form a group. Once a group has been established, it will be necessary for those students to work together through each of the modules in the program on subsequent days, a procedure that can last for weeks.

6. Assign each group a work station number and keep a close record of the names of the group members and their group number. Each group should work at the same workstation through the entire program, and with the same student data diskettes. Each student operating diskette will eventually hold all of the records of only those students who use that diskette. If a student uses a different diskette each work period, the records will be scattered among them all, and it will be difficult to retrieve them; for 30 or more students it would be too time consuming to be feasible.

7. As an extra precaution, label each diskette with the names of the students who will use it.

II. During the computer lab period.

1. At the beginning of the period have the students sit at their assigned workstations, with no exceptions. Then distribute the diskettes according to their corresponding numbers; the student names on the data diskettes should also correspond to the students who are at each workstation.

2. At the end of the period collect the diskettes and store them in numerical order to make their distribution at the next period easier.

3. Once you have established workstation groups, assignments, and procedures, resist any temptation to make changes unless the changes will clearly be to your advantage. As in any classroom, the closer you follow established procedures, the more control you will maintain over the period and the more effective the use of the software will be.

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TOPIC 1
Living and Non-Living Things

Aim: How can we tell living from non-living things?

Performance Objectives: Students will be able to:

- define the term "living organism"
- conclude from an experiment the difference between living and non-living things
- understand the purpose of a control in an experiment
- list those activities that are common to all living organisms

Materials:

- IBM computer lab
- software: Human Life Processes I: Cellular Physiology by IBM
- glass beaker, straw, bromthymol blue solution, four test tubes, a green plant, a rock, a snail

Do Now:

How can we determine if something is living?

Motivation: Demonstrate the following to the class:

- A beaker containing solution of bromthymol blue
- Have a student volunteer exhale through the straw into the solution in the beaker.
- Have the class observe and note the results.

What causes the color changes to occur? What gas was given off by the student that causes this color change?

In reviewing the student responses, elicit from them that the waste gas excreted, or given off, by the student produced the color change.

Have students conclude that all living things give off some form of waste gases during the process of living.

Development:

1. Show the results of the following experiment set up and demonstrated to the class at the end of previous class:

   4 test tubes, each containing a solution of bromthymol blue and one of these: a plant (such as elodea), a snail, a rock, and a control with nothing in it.

   Challenge the students to determine which test tube is the control and its purpose in the experiment (which is to act as a comparison to the other tubes).

2. Ask the students to write in their notebooks their prediction as to the contents of which tubes, if any, will turn yellow. Ask them to justify their prediction.

3. Review students' responses and then show the results of the experiment. Tell them that the program they are about to use will teach them the major life activities that are carried on by all living organisms and will also contain an exercise that will allow them to interact with the computer in order to understand this idea.

4. Remind the students of the correct method for handling discs and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

5. When the menu appears on the screen, instruct the students to select option 1 - "Exploring Life." A series of screens will appear that allows the students to review the motivational demonstration and to develop the concept of living and non-living things.

6. The computer-directed instruction includes an interactive exercise in which the student is presented with an object such as a plant, a snail, and a rock, and is asked to select from a list, those activities that apply to that object.

   At the conclusion of this exercise the students are presented with a color-coded key which indicates to them their answers, those that they missed or were incorrect. In the review the correct answers are displayed on a chart. The program indicates to the student the number of incorrect answers.

7. Following the life processes activity, an information screen defines the term "living organism" and lists nine major life processes.

8. Allow the students a reasonable amount of time to complete the computer-directed activity and to study the information screen. Suggested time is 10-15 minutes. Instruct the students to stop the program at the end of the information screen, to remove the disk from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers carefully without touching the recording surface.

Summary:

1. What is meant by the term "living organism"?
2. How are living things different from non-living things?
3. What is the purpose of a control in an experiment?
4. Why must all experiments contain a control?
5. In our class experiment today, which test tubes contained the variables? Which the control?
6. What is meant by a life process?
7. What life processes are carried on by all living organisms?

Homework:

1. What life processes are carried on by a tree? A fish?
2. List the life processes apparently carried on by a car.

3. Why isn't a car considered to be a living organism?
4. What is the essential difference between living and non-living things?

Enrichment:

Study some recent advances in our knowledge about viruses. Determine the classification of viruses: are they living or non-living things? Justify your conclusion.

TOPIC 2
The Cell Theory

Aim: Why is the cell considered to be the basic unit of structure and function in all living things?

Performance Objectives: Students will be able to:

- observe that the parts of living things have different structures
- recognize that the "basic building blocks" of these parts have certain similarities and differences
- understand the relationship between structure and function among the cells of the body
- recognize the contributions made by the early scientists such as Hooke, Schleiden and Schwann to the development of the cell theory
- identify certain cells such as heart muscle, nerve, skin, and plant stem cells
- understand the functions carried on by different kinds of cells

Materials:

- IBM computer Lab
- software: Cytolology and Histology I: by IBM
- microslide projector and slides of skin, leaf, blood vessel, plant root, plant stem, sand, and metal
- a leaf, a plant root and stem, a beaker of sand, and a piece of metal

Do Now:

Define each of these words: cell, vein, optical microscope, compound microscope

Motivation:

Display each of the following slides on a screen to the class:

- a layer of skin, a part of a leaf, a blood vessel, a plant root and stem, a piece of sand, and a piece of metal.

- Have the class analyze their observations. Which of these objects are living things? Which are non-living? List student responses on the board.

- In reviewing the student responses, elicit from them that living things are made of certain types of structures not found in the non-living things. Have the students conclude that all living things are made of basic units called the cell.

Development:

1. Demonstrate to the class where the samples of microscope slides may have come from. Show a leaf, a stem, and root of a plant. Have students look at the skin and veins on their arms. Show a sample of sand and a piece of metal.

2. Ask the students to imagine that they are "creating" cells that have different jobs to do. Elicit from the class the relationship between structure and function among the cells of the body. Are all cells similar? Why must they have different structure?

3. Have students draw several "imaginary" cells such as as those that might be found in blood vessels, skin, the top of a leaf, the tip of a plant root.

4. Briefly discuss with students the contributions of such early scientists as Hooke, Schleiden and Schwann, and their contributions to the development of the cell theory.

5. Tell students that the program that they are about to see will teach them about the cell theory and will also allow them to interact with the computer in order to learn about some different kinds of cells that may be found in plants and animals.

6. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

7. When the menu appears on the screen, instruct the students to select option 1 - Cell Theory.

8. The computer-directed instruction starts with a series of pictures and leads the students to understand that objects can be identified with the naked eye by differences in their structure. Students are then asked their opinions about nine microscopic enlargements. A summary chart of their answers is then presented. They learn that the microscopic structures of different living organisms are very similar in that they are made up of building blocks called cells. An information screen reviews several important concepts about the cell theory.

9. In the next segment students are asked to think about why there are so many different kinds of cells in a living organism. Students then view animated graphics of several kinds of cells. The function of each is described.

10. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained quiz. Suggested time is 10-15 minutes. Instruct the students to stop the program when they come to the diagram of the compound microscope, to remove the disk from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers carefully without touching the recording surface.

Summary:

1. Why do the parts of living things have different structures?
2. How can we prove that the "basic building blocks" of these parts have similarities and differences?
3. What is the relationship between structure and function among the cells of the body?

4. What contributions were made by the early scientists such as Hooke, Schleiden and Schwann to the development of the cell theory?
5. What is the cell theory?

Homework:

1. Draw and identify certain cells such as heart muscle, nerve, skin, and plant stem cells.
2. Describe the functions carried on by the different kinds of cells that you have drawn.
3. Describe the relationship between structure and function among the cells of living organisms.
4. Study about the development of the cell theory. The teacher should present appropriate assignments from the student text.

Enrichment:

Do further research on the development of the cell theory including contributions by others such as Leeuwenhoek, Brown, and Virchow.

Investigate recent discoveries about viruses. Do viruses "fit" into the cell theory? Justify your claim.

TOPIC 3
Systems of the Body

Aim: How are complex multicellular organisms organized?

Performance Objectives: Students will be able to:

- identify the cell as the basic unit of structure and function in living things
- define the terms colony and specialization
- identify the major groups of tissues of the body
- describe the role of organs in the body
- describe how systems are organized
- describe how complex organisms are organized

Materials:

- IBM computer lab
- software: Human Life Processses: II by IBM
- models and charts of the human body, a fish, a tree
- microprojector and slides of human tissues such as skin, muscle, nerve, blood

Do Now:

What is the basic unit of structure and function in all living things?
Why do they all look different?
In reviewing the students responses, elicit from them that:

1. They are all made of cells which are the basic structural and functional units of all living things.
2. These organisms look different because their cells have different shapes and carry out special functions.
3. There are certain similarities and differences among the cells of all living things.

Motivation:

Show models and charts of complex organisms such as the human body, a fish and a tree.

Development:

1. Let's look at some specialized cells that are found in the human body. Show some slides of specialized cells. Observe that each of these slides contain hundreds of similar cells. Elicit that a tissue is a group of similar specialized cells that work together as a unit in a multicellular organism and that there many different kinds of tissues in the human body.

2. Challenge the students to list in their notebooks as many tissues of the body they can think of and to briefly describe their functions.

3. Using a model or chart, show students some representative organs. Elicit that they consist of groups of tissues functioning together.

4. Elicit some of the basic life processes from the class. Elicit, too, the fact that the organs of the body are grouped together into systems and that these systems help the organism carry out the basic life functions.

5. Tell the students that the interactive program that they are about to use will teach them how the human body is organized, what major groups of cells and tissues it consists of, and will preview the major systems of the body.

6. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

7. When the menu appears on the screen, instruct the students to select option 1 - Systems.

8. The computer-directed instruction starts with a series of graphics which explains the role of the cell as a basic structural and functional unit, as well as the concept of a colony and a tissue. An animated graphic teaches the concept of specialization. An information screen and a quiz help summarize the concepts.

9. A series of graphics review the major tissue groups and their function. An information screen reviews the concepts.

10. An interactive activity tests students' comprehension by asking them to identify magnified views of several tissues of the the stomach. An information screen reviews the role of the stomach.

11. The students then preview a series of graphics that illustrate the systems of the body and the functions they perform. Have the students stop the program after viewing the endocrine system.

12. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained information screen. Suggested time is 10-15 minutes. Instruct the students to stop the program at the end of the information screen, to remove the disk from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers carefully without touching the recording surface.

Summary:

1. How can we prove that the cell is the basic structural and functional unit in all living things?
2. Why are there many different types of tissues in the human body?
3. What is the function of any one organ in the human body?
4. Name any system of the body and list its major organs. Indicate the function of each organ.
5. Describe the organization of the human body from its smallest to its largest functioning units.

Homework:

1. What is a colony?
2. Why are colonies important for the survival of simple organisms?
3. Name the tissues found in the human stomach and describe their function.
4. Define the term system. Name the systems reviewed in class today and describe their life function(s).
5. Have the students read appropriate section in their textbook that describes the organization of the body.

Enrichment:

1. Research a system of the body not studied in class today such as the immune system. List its parts and describe their function.

2. Someone once said,"All of the systems of the body function together as an integrated whole." Do you agree or disagree with this statement? Justify your position.

TOPIC 4
Atomic Theory of Matter

Aim: How can we describe the structure of matter?

Performance Objectives: Students will be able to:

- state that matter is made of atoms
- state that atoms are made of electrical particles
- identify the subatomic particles as the electron, proton and neutron
- identify the charge and location within an atom of the electron, proton, neutron, and nucleus
- describe the Bohr model of an atom
- calculate the total electrical charge of any atom
- identify the energy levels in an atom
- state the maximum number of electrons in the first three energy levels of an atom

Materials:

- IBM computer lab
- software: Structure of Matter by Classroom Consortia Media, Inc. (CCM)
- pith ball demonstration: pith balls suspended on ring stand, a piece of silk, a glass rod
- model(s) of atom(s) containing representative protons, neutrons and electrons

Motivation:

Show the classical pith ball demonstration:
  a. Rub the glass rod with a piece of silk.
  b. Bring the rod into contact with two suspended pith balls.
  c. Elicit that the silk "lost" electrons which adhered to the surface of the glass rod.
  d. Have the class conclude that electrons will transfer to a surface, such as the pith balls, that do not contain an excess of electrons.

Challenge the class to predict what will happen when the glass rod is removed. (The electrons transfer to the to the pith balls which now repel each other.)

- Why did the pith balls push apart?
- Encourage the class to make a generalization based on this information: "If the pith balls are coated with negatively charged electrons, what do like charges in general do to each other - attract, repel, or have no effect?" Have the students justify their answer.

Development:

1. Explain that over the past 100 years scientists have discovered many basic particles that make up the atom.

2. Elicit the names of the subatomic particles (electron, proton, and neutron). Write the names of the particles on the board.

3. Elicit the charges of the subatomic particles. Write the charges next to the names.

4. Ask students to define these terms: protons, neutrons, electrons, nucleus, orbit (energy level)

5. Draw and discuss the Bohr model of an atom.

6. Draw an atom of Helium. Demonstrate, if available.

7. Elicit location and contents of the nucleus and the electrons.

8. From the model (or drawing) challenge students to predict the electrical charge of the nucleus of any atom. (positive)

10. Have students determine why all atoms are electrically neutral. (no. of p+ = no. e-)

11. Have students observe energy levels in an atom.

12. Demonstrate energy levels K through N. Have students observe that the number of electrons increases as the distance from the nucleus increases. Demonstrate the maximum number of electrons in each energy level.

13. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

14. When the menu appears on the screen, instruct the students to select option #2 - The Bohr Model.

15. The computer-directed instruction will review the pith ball experiment and defines basic atomic structures including their characteristics and location in an atom. Animated graphics and information screens show the main energy levels of atoms. The students have several opportunities to work interactively with the computer to calculate the total charge of an atom, determine the electron population of the main energy levels, and to supply the electron configuration of several atoms.

16. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained information screen. Suggested time is 10-15 minutes. Instruct the students to stop the program at the end of the 2nd review quiz - Atomic Structure, to remove the disk from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers carefully without touching the recording surface.

Summary:

1. How can we prove that all matter is electrical in nature?
2. Name the fundamental subatomic particles and describe the electrical charge, if any, of each.
3. Tell where each subatomic particle is located in an atom.
4. Why are all atoms electrically neutral?
5. What are the energy levels in an atom?

Homework:

1. Have students study appropriate pages in their texts that describe the structures of atoms.
2. How would you make the two pith balls used in the class demonstration today hang next to each other without repelling each other?
3. How could you prove that electrons in the atoms of silk are easily removed?
4. Construct a simple chart showing energy levels K through N and the maximum number of electrons in each.
5. Draw a picture of an atom that has 13 electrons. How would you distribute the electrons?

Enrichment:

Research and report on the contributions made by any of the following persons to our understanding of the structure of the atom:

John Dalton, Niels Bohr, Sir Joseph Thompson, Ernest Rutherford, and James Chadwick.

TOPIC 5
Structure of the Atom

Aim: How can we draw a diagram of an atom?

Performance Objectives: Students will be able to:

- explain how the periodic table may be used to determine all of the following for any element: chemical symbol, atomic mass, atomic number, the number of protons, neutrons and electrons
- draw a Bohr model of any atom

Materials:

- IBM computer lab
- software: Structure of Matter by Classroom Consortia Media (CCM)
- model of atom and its parts
- periodic Table - demonstration and class set for students
- hand out sheet - Rules for Drawing Atoms
- overhead projector and transparencies of hydrogen, helium, and neon atoms

Motivation:

Using a model, a review of the parts of the atom is presented to the class.

Demonstrate the periodic table to the class. Challenge the class to predict how the periodic table can be used to tell us detailed information about the structure of the atom.

In reviewing student responses, elicit from them that the numbers and letters shown on the periodic table must help us to identify each atom and that the differences between them are determined by their differing number of protons, neutrons, and electrons. Show a projection of hydrogen and show its unique characteristic (only atom with no neutron).

Development:

1. Hand out periodic tables to students.

2. Display a transparency of helium atom. Have students copy the in diagram into their notebooks.

3. Using the periodic table elicit from the class that it can be used as a source for all information needed to draw a Bohr model of an atom of any element.

4. Challenge students to determine helium's symbol, atomic number, and atomic mass. Have students understand that the number of protons, neutrons, and electrons of any atom are obtained from its atomic mass and atomic number.

5. Have students look up neon in their periodic table. Challenge them to draw its nucleus and electron configuration. Ask them to compare their results with a demonstrated projection of that element.

6. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

7. When the menu appears on the screen, instruct the students to select option #3 - How to Draw an Atom.

8. The computer-directed instruction starts with a review of the parts of the atom. Graphics of several atoms and their Bohr models are presented.

9. Lithium is used to show the periodic table as a source of all information needed to draw a Bohr atom. An interactive segment allows the student to determine atomic mass, number and electron configuration. A similar activity is done with the element neon. Students determine its electron configuration, which is then added to the graphic.

10. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained information screen. Suggested time is 10-15 minutes. Instruct the students to stop the program at the end of the neon exercise, to remove the disk from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers carefully without touching the recording surface.

Summary:

1. How is the atomic number of an atom shown on the periodic table?
2. What does the atomic mass of an atom represent? How is it shown on the periodic table?
3. What information on the periodic table helps you to determine the number of electrons in an atom.
4. The periodic table does not indicate the number of neutrons. How can you determine their number?

Homework:

1. Describe how the periodic table can be used to give us detailed information about the structure of any element.

2. Use the periodic table to draw atoms of argon, aluminum, carbon, hydrogen, and magnesium. For each element listed, state the chemical symbol, atomic mass and atomic number, and show the energy levels with their correct electron configuration.

Enrichment:

Research and report to the class on the following question:

Some heavy elements have 70, 80, or more electrons. What happens to their electrons beyond the N energy level?

TOPIC 6
Formation of Ions

Aim: How do ions form?

Performance Objectives: Students will be able to:

- identify valence electrons from diagrams or models
- describe how an atom's valence electrons affect its ability to form compounds
- define the term "stable octets"
- explain the relationship between stable octets and the formation of ions
- correlate the relationship between the oxidation state of an atom and its valence electrons

Materials:

- IBM computer lab
- software: Structure of Matter by Classroom Consortia Media, Inc. (CCM)
- overhead projector, transparencies and/or models of argon, fluorine, magnesium and neon

Motivation:

- Show an overhead transparency ot a Bohr model of an atom of argon. Ask students to copy it, and elicit from them its atomic number, atomic mass, electron configuration, its positive charge (# of protons), negative charge (# of electrons), and the total charge on the atom.

Development:

1. Using the argon model and/or transparency discuss and elicit from the class the following concepts:
   a. why all atoms are electrically neutral.
   b. the term valence orbit and its location in an atom.
   c. the term valence electrons and their atomic location.
   d. why only valence electrons are involved in the formation of chemical compounds.

2. Demonstrate projections or models of these elements: fluorine, magnesium, and neon

3. Elicit the number of valence electrons in each and the term stable valence orbit. Have class determine which one has a stable valence orbit and is therefore inert. Elicit the expression stable octet.

4. Discuss the concept of loss and gain of electrons during chemical change. Have the class predict which atoms lose, gain, or share electrons during chemical change. Define the terms metals, non-metals, and metalloids in terms of loss, gain or sharing of electrons. Define covalent compounds as those that share electrons during chemical change.

5. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

6. When the menu appears on the screen instruct students to select option #4 - ions.

7. The computer-aided instruction starts with graphic representation of a Bohr krypton atom. Information such as atomic number, mass,electron configuration, electron and proton numbers, and total charge are elicited.

8. Information is presented about valence electrons and students interactively determine the valence electrons and their number from several atoms. The concept of stable octets is developed and is applied to the formation of several metallic and non-metallic ions. The properties of metalloids are discussed and demonstrated.

9. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained information screen. Suggested time is 10-15 minutes. Instruct the students to stop the program at the end of the information screen, to remove the disk from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers carefully without touching the recording surface.

Summary:

1. How can we identify valence electrons from diagrams or models of atoms?
2. How does an atom's valence electrons affect its ability to form compounds?
3. How can atoms obtain a stable octet if they do not have one?
4. What is the relationship between stable octets and the formation of ions?
5. What is the relationship between the oxidation state of an atom and its valence electrons?

Homework:

1. Have the students read the appropriate section in their textbooks concerning the formation of ions.

2. Complete the enclosed chart

Enrichment:

Have the students research, answer this question, and report their finding back to the class:

"Organic compounds tend to consist of covalent compounds while most inorganic compounds are ionic in their makeup."

Is this statement true? If so, why?

WORKSHEET — Formation of Ions

Name ____________________ Class ________ Date __________

Fill in the missing blanks in the chart below. Use Periodic Table for symbols

Element	At. #	At. Mass	# E	Mtl/Non-mtl	Ox. State	Ionic Chg	Gn/lose E's	El. config
Li	3	7				+1	L	2/1
		35	17	NM	-1			
	19	39		M	+1			2/8/8/1
Br	35	80		NM			G	
		16	8			-2		
Ca		40	20	M			L	
	1	1	1			+1		1

PART II: For each of the above elements, draw a Bohr model of each atom

TOPIC 7
Chemical Bonding

Aim: How are compounds formed by ionic bonding?

Performance Objectives: Student will be able to:

- describe the electron transfer that occurs between a metallic and non-metallic element
- explain the concept of ionic bonding
- draw a diagram illustrating an example of ionic bonding
- explain how compounds are formed by ionic bonding
- explain the relationship between the formula of a compound and the number of atoms that it contains
- describe why some compounds need more than one metallic or nonmetallic atom

Materials:

- IBM computer lab
- software: Structure of Matter by Classroom Consortia Media (CCM)
- models of calcium and oxygen atoms
- conductivity apparatus
- distilled water, salt

Motivation:

Explain to the class that some kinds of compounds, when dissolved in water, ionize or split into ions and are thus able to conduct an electric current. These compounds are called ionic compounds.

Demonstrate with a conductivity tester, testing first distilled water, then distilled water containing salt.

Repeat demonstration with a sugar solution.

Explain that ionic compounds ionize in solution and are therefore conductors of electricity while covalent compounds do not ionize and are therefore non-conductors of electricity.

Let's find out how ionic compounds are formed.

Development:

1. Display models of calcium and oxygen atoms. Draw Bohr atom diagrams on the board. Elicit from the class the number of valence electrons for each atom.
2. Challenge the students to determine what must happen to each atom in order for it to have a stable octet electron configuration.
3. Lead the class to conclude that metals are electron donors during chemical reactions and that non-metals are electron receivers.
4. Illustrate the electron transfer that occurs when calcium chemically combines with oxygen.

5. Have the class determine:
    a. which element is the metal, which the non-metal?
    b. what is the charge of the calcium ion, the oxygen ion?
    c. how many electrons will calcium lose and oxygen gain?
    d. what is the oxidation state of the calcium ion, the oxygen ion?
    e. what is the formula of the compound formed?

6. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

7. The computer-aided instruction starts with an animated graphic showing the electron transfer between sodium and chlorine and the compound formed by them. Definitions of ion and ionic bond are presented.

8. Similar animations are presented for the following pairs: magnesium and oxygen, sodium and sulfur, and aluminum and oxygen.

9. Students are led through these kinds of activities: determining which atoms gain or lose electrons, the charge on each ion, the charge on the compound, and determining which ion is metallic or non-metallic. Students are presented with the formula of each compound at the end of each exercise.

10. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained information screen. Suggested time is 10-15 minutes. Instruct the students to stop the program at the end of the information screen, to remove the disk from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers carefully without touching the recording surface.

Summary:

1. What kind of electron transfer occurs between a metallic and non-metallic element during the formation of an ionic compound?
2. What is meant by the term ionic bonding?
3. What determines how many electrons an atom will lose or gain during the formation of ionic compounds?
4. How does drawing Bohr models of atoms that illustrate ionic reactions help to predict the oxidation state of each ion?
5. What is the relationship between the formula of a compound mand the number of atoms that it contains?
6. Some compounds need more than one metallic or non-metallic atom. Why is this so?

Homework:

Prepare a rexographed worksheet that challenges students to predict the structure of atoms, their oxidation state, whether they are metals or non-metals, and the kind of ions they form.

1. Draw a diagram illustrating an example of ionic bonding using any two correct elements listed on the worksheet.

Enrichment:

Research in science texts or encyclopedia about covalent compounds. Describe how they are similar and different from ionic compounds. What kind of compounds are generally found in the covalent group?

valence electrons	electrons gained	electrons lost	oxid. state	inert Y/N	metal Y/N	nonmetal Y/N	metalloid Y/N
3							
7							
8							
5							
6							
4							

TOPIC 8
Organic Compounds

Aim: What roles do organic compounds play in living organisms?

Performance Objectives: Students will be able to:

- contrast the characteristics of heterotrophic and autotrophic organisms
- explain the need for the digestion of food in living organisms
- describe an experiment that illustrates the need to digest foods that contain starch
- list the products obtained from the hydrolysis of food
- describe what a cell does with the end products obtained by hydrolysis
- distinguish between the processes of hydrolysis and dehydration synthesis in terms of their original substances and the end products produced
- describe the role of enzymes and water during the processes of dehydration synthesis and hydration

Materials:

- IBM computer lab
- software: Chemicals of Life II: by IBM
- appropriate diagrams of a tree, a dog, a microorganism such as Volvox, a human being
- model of an organic compound
- live plant and animal

Do Now:

Define: organic compound, inorganic compound, carbon-hydrogen bond, hydrolysis, dehydration synthesis

Motivation:

Show a diagram of any four living things such as a tree, a human being, a microorganism, and a dog. Show a model of an organic compound. Elicit from the class that the element carbon is most responsible for life on this planet as we know it.

Development:

1. Elicit from the class the definition of organic compounds as those that form hydrogen to carbon bonds and that proteins, carbohydrates, lipids and nucleic acids are the four major group of organic compounds.

2. Show a live plant and animal. Elicit from the class that some organisms such as the plant are autotrophic because they manufacture their own organic compounds whereas other organisms are heterotrophic since they must obtain organic compounds by eating other living things.

3. In reviewing students responses, tell them that the program they are about to use will teach them about organic compounds, how they are broken down as well as synthesisized and utilized in living organisms.

4. Demonstrate the ionization of each compound with the conductivity apparatus.

5. Show the formulae for several acids. Explain that acids contain H+ in solution which gives them their chemical properties.

6. Show the formulae for several common bases. Elicit that the OH- ions give bases their chemical properties.

7. Explain that salts are derived from the chemical reaction between acids and bases and contain neither H+ nor OH- ions when in solution.

8. Introduce the computer activity and remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

9. When the menu appears on the screen, instruct the students to select option 1 - Inorganic Compounds. This will review the material which was introduced previously in class and during the motivation exercise.

10. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained information screen. Suggested time is 10-15 minutes. Instruct the students to stop the program at the end of the information screen, to remove the disk from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers carefully without touching the recording surface.

Summary:

1. What is the composition of the protoplasm in living things?
2. What are some of the elements found in large quantities in living things?
3. What are trace elements?
4. What are the four common elements that make up the inorganic compounds?
5. What happens to acids, bases, and salts when they ionize in water solutions?
6. How does pH help us determine the strength of acids and bases?
7. How can we determine the pH of a solution.

Homework:

1. Have the students read the appropriate section in their textbook that relates to inorganic compounds in living things.

2. Explain the essential differences between inorganic and organic compounds.

3. Why are trace elements significant in the human body?

4. Explain why some acids and bases may be strong, others weak. Give examples of both groups of compounds.

5. What acid is commonly found in the stomach? Is it strong or weak?

4. Pasta is a food that contains starch. Describe an experiment that illustrates what happens in the mouth to foods that contain starch.

Enrichment:

Complete the attached chart.

WORKSHEET — Organic Compounds

Name __________________________ Class _________ Date ___________

Food nutrients	Soluble molecules from Hydrolysis	Dehydration Synthesis End Prodicts (insoluble) →	Function(s)
Proteins	Amino acids		
Carbohydrates			Heat & energy
Lipids		Lipids	
		Nucleic Acids	

TOPIC 9
Inorganic and Organic Compounds

Aim: What inorganic substances are found in living things?

Performance Objectives: Student will be able to:

- explain that protoplasm is composed of elements.
- list some of the elements found in large quantities in living things.
- define and give examples of trace elements.
- Give examples of the four common groups that make up the inorganic compounds.
- describe the ionization of acids, bases and salts in water.
- define the term pH and describe the factors that determine the pH of acids and bases.

Materials:

- IBM computer lab
- software: Chemicals of Life II by IBM
- models of an organic compound, inorganic acids, bases, and salts
- conductivity apparatus
- human torso model

Do Now:

List all of the elements which are found in the human body.

Motivation:

Using a model, review the organization of a living thing from its largest to its smallest components. Elicit from the class that all living things are made up of the same basic chemical components - namely, the elements.

Development:

1. Elicit from the class the six most common elements that make up 98 per cent of an organism's weight.

2. Explain trace elements as those that comprise the remaining two per cent of body weight.

3. Demonstrate models of inorganic and organic compounds. Explain that living things consist of molecules of organic compounds. Elicit that in organic compounds the carbon and hydrogen atoms are most commonly bonded together. Have students list some common organic compounds such as fats, oils, proteins and carbohydrates.

   Explain that inorganic compounds do not generally form bonds between carbon and hydrogen atoms. Some inorganic compounds are found in living things. Demonstrate sample molecules of water, a salt, an acid, and a base. Elicit their formulae from the students. Elicit the name of the group of compounds to which each belongs (inorganic salts, inorganic acids, etc.).

4. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computers.

5. When the menu appears on the screen, instruct the students to select option #2 - Organic Compounds. This will review the material which was introduced during the motivation exercise.

6. The program begins with several screens that introduce organic compounds, compare autotrophic with heterotrophic organisms and explain the need for digestion.

7. An experiment demonstrates the action of saliva on a starch food molecule.

8. The hydrolysis of food from large complex molecules to soluble end products is demonstrated. Students interact with the program and attempt a matching quiz.

9. Dehydration synthesis is shown and the program demonstrates the insoluble end products that are formed and their function.

10. A review of basic concepts learned is presented, followed by a fill-in quiz which tests students about the end products of hydrolysis, dehydration synthesis products and their uses.

11. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained information screen. Suggested time is 15 minutes. Instruct the students to stop the program at the end of the quiz screen, to remove the disk from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers.

Summary:

1. How are the characteristics of heterotrophic organisms similar and different to those of autotrophic organisms?
2. What are the products obtained from the hydrolysis of starch?
3. Describe what happens to the end products obtained by hydrolysis in the cells of the body.
4. Describe the role of enzymes and water during the processes of dehydration synthesis and hydration

Homework:

1. Why is carbon (C) considered to be the "element of life" in all living things?

2. Describe where each of the following processes occurs, and the role that each plays in the human body:
   a) hydrolysis of food
   b) dehydration synthesis

3. Can a hamburger be used by the cells of the body in the form in which it is eaten? Explain your answer.

Enrichment:

Research and report on the role of trace elements and their physiological functions such as:

1. Sodium and its roles in kidney function, water balance in the body and nerve impulse transmission.
2. Potassium and its role in affecting heart beat rate.

TOPIC 10
Carbohydrates

Aim: How are carbohydrates used by living organisms for heat and energy?

Performance Objectives: Student will be able to:

- describe the hydrolysis of carbohydrates
- describe the formation of monosaccharides and their function
- list the reactants and products of the dehydration synthesis of monosaccharides
- write the molecular formula and draw the structural formula of a monosaccharide
- define and give examples of polymers and polysaccharides
- describe the uses of carbohydrates in plants and animals

Materials:

- IBM computer lab
- software: Chemicals of Life II by IBM
- previously set up classroom demonstration
- models of organic molecules: mono-, di-, and polysaccharides;

Do Now:

Why must we digest foods? Why must nutrients be converted to a soluble form prior to use by the body?
define: polysaccharide, monosaccharide, membrane

Motivation:

Show the following previously set up demonstrations to the class:

1. Beaker # 1 containing a Goldbeater's membrane filled with a sucrose solution. The membrane is immersed in distilled water.
2. Beaker # 2 containing a Goldbeater's membrane filled with a glucose solution. The membrane is immersed in distilled water.
    A. Explain that the Goldbeater's membrane is analogous to a cell's plasma membrane.
    B. Test the distilled water from both beakers for the presence of simple sugar.

What caused the results that you observe? What must happen to the polysaccharide sucrose molecule before it can enter the cell?

Development:

1. Display a model of a carbohydrate molecule or place a diagram on the board. Challenge students to demonstrate its hydrolysis into simple, soluble molecules called monosaccharides. Elicit the molecular formula $C_6H_{12}O_6$ for all of them. Demonstrate a disaccharide molecule.

2. Elicit that only monosaccharides can enter the cell to be utilized by the cell for the production of heat and energy.

3. Demonstrate how two glucose molecules make up a single maltose molecule. Introduce dehydration synthesis and explain to the students that monosaccharides can combine to form polysaccharides.

4. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

5. When the menu appears on the screen, instruct the students to select option #3 - Carbohydrates.

6. The program begins with screens that illustrate the structural formulas of several monosaccharides and explain that they are the end products of carbohydrate hydrolysis. Students interactively investigate the structures of these molecules. Terms such as molecular formula, structural formula and isomer are demonstrated and explained.

7. The student are shown how glucose and fructose are used by the cell. A molecule of glucose is demonstrated. The roles of glucose, ATP, and ADP in the production of cellular energy are explained.

8. The storage of excess glucose is demonstrated. Students see glucose molecules reacting to form the disaccharide, maltose. Dehydration synthesis is defined. A second disaccharide, sucrose, is synthesized. The formula for the plant polysaccharide - starch, is shown and a compound used by animals for energy storage - glycogen, is compared to it. Polymers are defined and examples, such as cellulose, are described.

9. This section ends with a demonstration of the hydrolysis of starch into glucose molecules.

10. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained information screen. Suggested time is 12-1 minutes. Instruct the students to stop the program at the end of the starch hydrolysis screen, to remove the disc from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers without touching the recording surface.

Summary:

1. What is a monosaccharide?
2. How are monosaccharides derived?
3. What is the molecular formula of a monosaccharide?
4. What is the function of monosaccharides in the body?
5. How is excess glucose stored in the body?
6. What are the functions of ADP and ATP during cellular respiration?
7. How would you define polysaccharides and polymers?
   What are some examples of each compound?
8. What happens during the dehydration synthesis of monosaccharides?
9. What are some uses of carbohydrates in plants and animals?

Homework:

1. Have students read the appropriate section in their textbooks on carbohydrates.
2. Name three common monosaccharides. Write the molecular formula and draw the structural formula for each.
3. Define the terms isomer and polymer. Give examples of each.
4. Describe the use of glucose and fructose in the body. Explain how they are stored when necessary.
5. What must an organism do when it uses up its monosaccharides?
6. Write the word formula for each reaction that includes the reactants involved and the products formed: hydrolysis and dehydration synthesis of carbohydrates.

Enrichment:

1. What are some similarities and differences among the compounds in each of the following sets?
    - a) glucose, fructose and galactose
    - b) starch and cellulose
    - c) amylopectin and amylose
    - d) sucrose and maltose

TOPIC 11
Lipids

Aim: How are lipids used by living organisms?

Performance Objectives: Student will be able to:

- write the structural formula for a lipid, fatty acid, and glycerol
- write the reaction for the hydrolysis of a lipid
- describe the dehydration synthesis of lipids
- define the terms: lipids, fatty acids, organic acid, and alcohol
- compare the process of hydrolysis with that of dehydration synthesis of lipids
- compare saturated with unsaturated fats
- state how cholesterol is produced in the human body
- describe the relationship between cholesterol and atherosclerosis

Materials:

- IBM computer lab
- software: Chemicals of Life II by IBM
- models of organic compounds such as lipids, fatty acids, glycerol, and a carbohydrate
- materials for class demonstration: ring stand, triangle, 25 ml beaker, large nut, forceps, matches

Do Now:

Define each of these terms: lipid, fatty acid, alcohol, saturated fat, unsaturated fat, cholesterol

Motivation:

Set up the following demonstration in front of class:
What basic food nutrients are found in this nut? Elicit that it contains mostly protein and lipids (oils). What are the basic functions of fats and oils (lipids)? Elicit that lipids are an excellent source of energy for the body.

Demonstrate this by having a student ignite the nut beneath the 10 ml of water in the beaker. Record the temperature of the water prior to heating. Determine the change in temperature of the water and calculate the number of calories of heat energy produced by the burning peanut.
1 calorie = the heat required to raise the temperature of 1 gram of water 1 degree celsius.

Development:

1. Demonstrate a model carbohydrate molecule. Review previous material by eliciting that it is a model of a carbohydrate molecule.

2. Demonstrate a lipid molecule and compare the two. Derive the chemical formula from the class. Elicit from the class that this molecule is too complex to be used in its present form by the body and that it must be hydrolysed in order to pass through the villi and enter the body and the cells. Demonstrate hydrolysis and elicit the end products

as fatty acids and glycerol - soluble molecules that can be utilized by the cells of the body for energy.

3. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

4. When the menu appears on the screen, instruct the students to select option 4 - Lipids.

5. The computer-directed instruction starts with an information screen that shows the molecular structure of a lipid molecule. Subsequent screens explain that complex molecules must by hydrolysed in order to form soluble, usable molecules.

6. Animated, interactive graphics demonstrate lipid hydrolysis and the dehydration synthesis of lipids. The terms organic acid and alcohol are explained, the carboxyl and hydroxyl groups are identified and their participation in the reaction is graphically demonstrated.

7. The program compares carbohydrate and lipid molecules in terms of structure and function in the body.

8. An information screen compares saturated and unsaturated fats, explains the formation of cholesterol, and describes the possible relationships between cholesterol and atherosclerosis and heart attacks.

9. A review screen summarizes some basic facts about lipids.

10. Allow the students a reasonable amount of time to complete the computer-directed activity. Suggested time is 10-15 minutes. Instruct the students to stop the program at the end of the information screen, to remove the disk from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers carefully without touching the recording surface.

Summary:

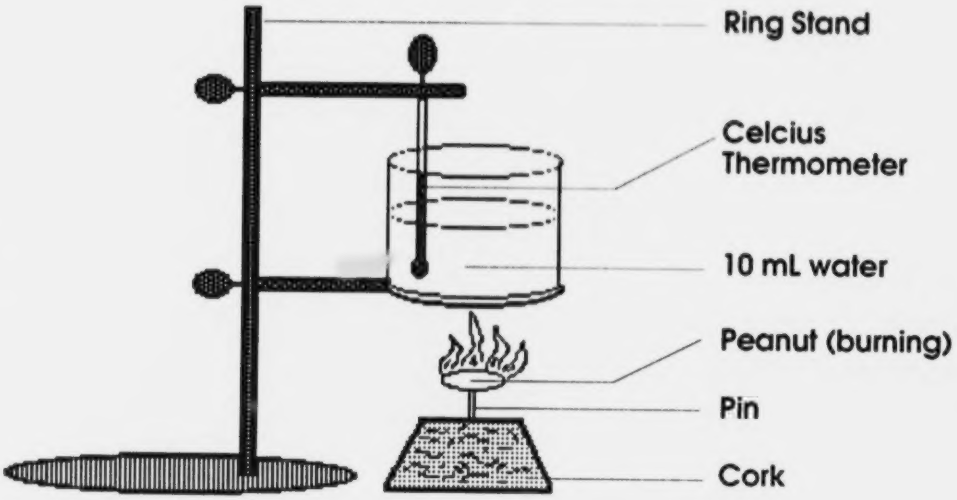
1. Draw the structural formula for a lipid, fatty acid, and glycerol?
2. How would you describe the reaction for the hydrolysis of a lipid?
3. What are the reactants and end products produced during the dehydration synthesis of lipids?
4. What are lipids, fatty acids, organic acids, and alcohols?
5. What are the differences between the hydrolysis and dehydration synthesis of lipids?
6. How do the chemical bonds in unsaturated fats compare with those of saturated fats?
7. How is cholesterol produced in a living organism?
8. Why is a high cholesterol count in the blood dangerous to a person's health?

Homework:

1. Have students read appropriate section on lipids in their textbooks.
2. Write the molecular formula for a lipid and its structural formula. Remember to use the letter R to represent the long chain carbon-hydrogen part of the molecule.
3. Use structural formulae to write the hydrolysis and dehydration synthesis reactions of lipids.
4. Is there a relationship between one's diet and the development of vascular diseases such as atherosclerosis and coronary occulsion (heart attack)?

Enrichment:

1. Research and report to the class on how the body uses cholesterol to help maintain normal functioning.
2. What part of fatty acid and glycerol molecules act as a source of high energy for the cell?



TOPIC 12
Proteins

Aim: How are proteins changed so that they can be used by an organism?

Performance Objectives: Student will be able to:

- define the term protein
- list several sources of protein
- describe the chemical composition of amino acids and explain how each one is different
- draw a structural diagram of an amino acid molecule
- explain how a dipeptide molecule forms
- explain the differences between dipeptide and polypeptide molecules
- explain why the hydrolysis of protein is essential in a living organism
- describe the hydrolysis of protein molecules

Materials:

- IBM computer lab
- software: Chemicals of Life III by IBM
- model of torso
- model of a cell
- transparencies of structural formulae of amino acids, a dipeptide, and a polypeptide
- overhead projector
- a green plant

Do Now:

Define: protein, amino acid, peptide, polypeptide, dipeptide

Motivation: Demonstrate the following to the class:

1. Show the torso of the human body and identify some of its major organs.

2. Show a typical cell and identify its major parts. What structural similarities do all living things have in common whether macroscopic (the torso) or microscopic (the cell)?
   Elicit from the class that all parts of living things are made of proteins.

Development:

1. Display the green plant to the class. Elicit from the class that the plant consists of proteins which it manufactured from simple inorganic substances.

2. Display the torso and elicit from the class that animals and non-photosynthetic plants obtain their proteins from other organisms.

3. Demonstrate the structure of a protein molecule. Elicit from the class that the molecule is extremely complex and must be hydrolyzed, or broken down, into simple, soluble molecules in order to pass through a membrane and be usable by a living organism. Display the amino acid molecule. Elicit or explain to the class that amino acids are the building blocks

of proteins.

4. Elicit from the class that due to the complex nature of proteins, these molecules are constructed in each cell in a step-by-step manner by joining and that this process is called dehydration synthesis. What do we mean by dehydration?

5. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

6. When the menu appears on the screen, instruct the students to select option 2 - Proteins.

7. The computer-directed instruction starts with an explanation of the importance of proteins. This is followed by screens that describe some uses of proteins and their source.

8. Several graphics show a magnified view of a protein molecule and an amino acid. The major components of an amino acid are identified by the student. Students observe different amino acids.

9. A screen provides information about amino acids including their characteristics.

10. Animated graphics demonstrate how proteins are formed from amino acids. A dipetide molecule with its dipeptide bond is shown, and the terms polypeptide and protein are defined.

11. The process and reason for protein hydrolysis is described and students see an animated graphic showing dipeptide hydrolysis with emphasis on the role of the peptide bond. Students observe the formation of amino acids.

12. A screen then reviews major concepts learned. A fill-in quiz completes this section. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained review. Suggested time is 15-20 minutes. Instruct the students to stop the program at the end of the information screen, to remove the disk from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers carefully without touching the recording surface.

Summary:

1. How would you define the term protein?
2. What are several sources of protein?
3. What is an amino acid? Can you explain how one amino acid differs from another?
4. How would you draw a structural diagram of an amino acid molecule? What components must you include?
5. Where do dipeptide molecules come from? How do they form?
6. What are some differences between dipeptide and polypeptide molecules?
7. Why is the hydrolysis of protein essential in a living organism?

Homework:

Have students read appropriate section in their textbooks concerning proteins and their structure.

1. Why are amino acids considered to be the building blocks of proteins?
2. Name the various components of a typical amino acid molecule. Draw the structural formula of an amino acid.
3. How does a dipeptide molecule form from amino acids during dehydration synthesis?
4. Name the reactants and products formed during the hydrolysis of a protein molecule. What enzyme, if any, is involved in this process?

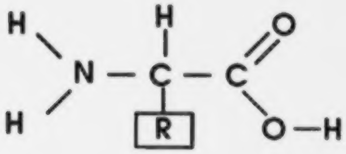
Enrichment:

1. Research and report to the class the role played by cellular ribosomes in the production of cell proteins.

WORKSHEET — Proteins

Name ______________________ **Class** _______ **Date** _________

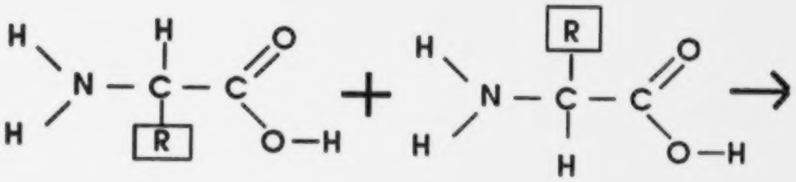
Chart 1



1. Identify and label the Amino group, the Carboxyl group, and the side chains.

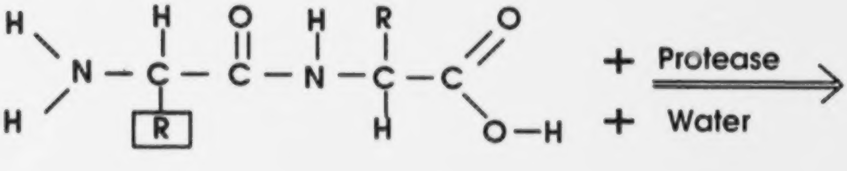
2. Name the three parts of the carboxyl group:
   1. ________________
   2. ________________
   3. ________________

Chart 2 Dehydration Synthesis of Amino Acids


H
H
N
C
C
O
O—H
R
+
H
H
N
C
C
O
O—H
R
→

1. Draw a diagram of the resultant compound.
2. What other molecule is also formed during this reaction? ______________
3. Locate and identify the peptide bond.

Chart 3 Dipeptide Hydrolysis


H
H
N
C
C
O
N
H
C
R
H
C
O
O—H
R
+ Protease
+ Water

1. Show the products formed in the presence of protease and water.

2. What do we call these two products?

3. What are their uses in the body?

TOPIC 13
Nucleic Acids

Aim: What is the role of DNA in a living organism?

Performance Objectives: Students will be able to:

- list and describe the functions of the chemicals that are found in the cell nucleus
- explain the term nucleotide
- identify a DNA molecule in terms of each of its components: its four bases, its sugar and high energy group
- list the pairs of DNA nucleotides that are purines and pyrimidines
- describe the components of the purine and pyrimadine parts of a DNA molecule
- describe the interactive role of DNA nucleotides during the production of DNA
- explain how DNA is a self-replicating molecule.

Materials:

- IBM computer lab
- software: Chemicals of Life III: Proteins and Nucleic Acids by IBM
- models, charts, and/or transparencies of:
  a. typical cell - with removable parts
  b. model of a cell nucleus
  c. DNA - double helix

Motivation: Demonstrate the following to the class:

A model of a typical cell. Elicit that the nucleus controls cell activities. Challenge the students to consider how the nucleus is able to carry out its functions.

Development:

1. Demonstrate and elicit the names and functions of the chromosomes and genes of the nucleus of a cell. Demonstrate the DNA model and how the double helix is able to "unzip" and then replicate itself. Challenge students to develop the concept of DNA as acting as a template for other cellular components thereby controlling their function.

2. Review students responses and tell them that the program they are about to use will teach them about the nature of nucleic acids and will also allow them to interact with the computer in order to identify the components of DNA molecules and how they are bonded together.

3. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

4. When the menu appears on the screen, instruct the students to select option 1 - Nucleic Acids.

5. The computer-directed instruction starts with an inquiry as to why organisms of a species look essentially alike. The program continues with an investigation of the chemicals found in the cell nucleus.

6. A series of interactive screens and animated graphics illustrate the nature of the DNA molecule, its components, and how these components are bonded togther.

7. Students study the individual nucleotides of the DNA molecule, learn their parts, and why they bond only in specific pairs.

8. Students learn the factors that determine the structure and function of cellular proteins and that consequently DNA directs cell activities and an organism's traits.

9. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained review. Suggested time is 15 minutes. Instruct the students to stop the program at the end of the 6 question matching quiz screen, to remove the disk from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers carefully without touching the recording surface.

Summary:

1. What are the organic chemical compounds that are found in the nucleus of a cell? What are their functions?
2. How would you define the term nucleotide?
3. What are the characterisitics of a DNA molecule?
4. What are the four bases of a DNA molecule? What kind of sugar and high energy component does it contain?
5. What are some examples of pairs of DNA nucleotides?
6. Which of these nucleotides are classified as purines and which as pyrimidines?
7. What are the the components of purines and pyrimadines?
8. How do DNA nucleotides interact in the production of DNA?
9. What is the process that makes DNA a self-replicating molecule?
10. How does DNA direct cell activities and determine the traits of an organism?

Homework:

1. Construct a simplified model that demonstrates the double helix nature of the DNA model.
2. Identify and label the parts of each of the four DNA nucleotides, including the base, sugar, and phosphate group.
3. Explain how the DNA molecule has the capability of self-replication.
4. How does DNA control the type of protein made by the cell?
5. How does DNA direct cell activities and determine the traits of an organism?
6. Complete the fill-in diagram of a DNA molecule. Label the matching base pairs.

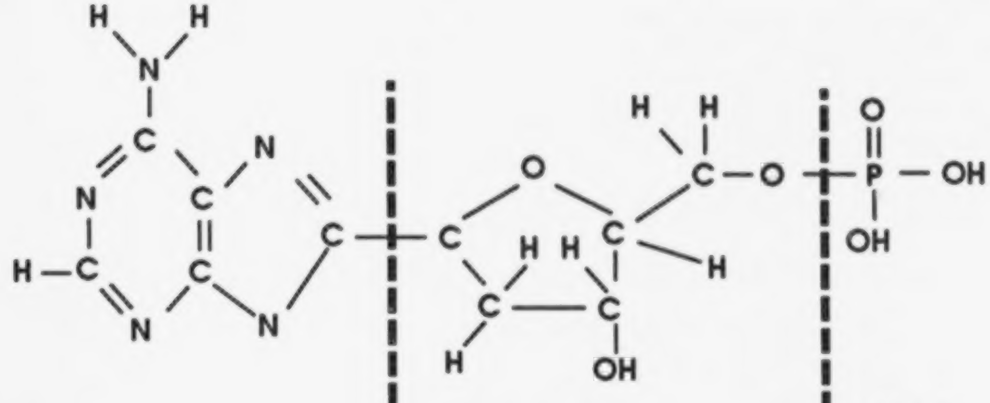
Enrichment:

Research and report on the role of DNA as the chemical that determines the characteristics of living organisms. Include information why individuals (except clones) are never absolutely identical.

WORKSHEET — Nucleic Acids

Name ______________________ Class ________ Date __________

I. The Structure of a Nucleotide


H
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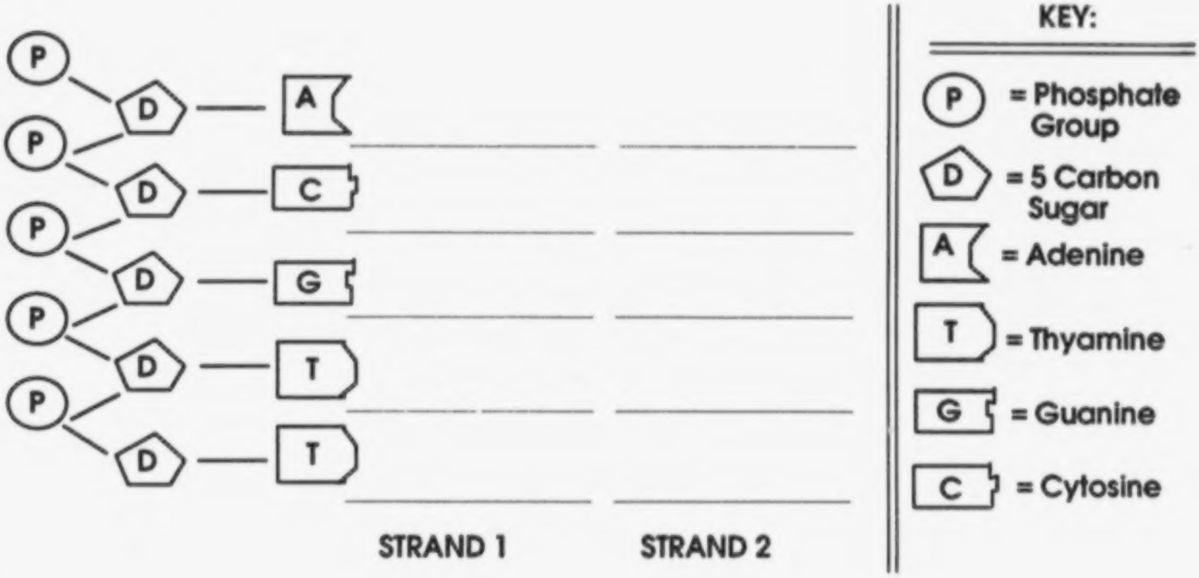
C
H
C
OH
H
H
C
O
O
P
OH
OH
H

The ______________
Adenine

The Simple 5-Carbon
Sugar____________

The High
Energy
Group__________ ____

II.


P
D
A
P
D
C
P
D
G
P
D
T
P
D
T
STRAND 1
STRAND 2
KEY:
P = Phosphate Group
D = 5 Carbon Sugar
A = Adenine
T = Thyamine
G = Guanine
C = Cytosine

1) Draw the missing complementary half of the connected polynucleotide chain.

2) Label and name all of the nucleotide pairs.

TOPIC 14
Enzyme Action

Aim: How can enzyme action be understood based on information from inhibitors?

Performance Objectives: Student will be able to:

- explain the functions of enzymes in living cells
- describe the lock-and-key model of enzyme action
- explain the function of an inhibitor on an enzyme
- explain the effect of different concentrations of inhibitors on enzyme action

Materials:

- IBM computer lab
- software: Enzyme by DEE Inc.

Motivation: Place the following statement on the board:

> Acetylcholine is a chemical transmitter that relays information between neurons. It is usually broken down by the enzyme acetylcholinesterase very shortly after it is released. If a particular molecule, called an inhibitor, is present in the synapse between the neurons they would continue to 'fire' abnormally because the acetylcholine isn't broken down. The inhibitor is similar in shape to the acetylcholine molecule.
>
> Ask the students to try to explain this phenomenon based on their knowledge of the lock-and-key model of enzyme action.

Development:

1. Review the role of enzymes in life processes. Discuss the implications of impaired enzyme function, i.e. slower reaction rates, eventual death of the organism, etc.

2. Review the lock-and-key model of enzyme action. Discuss the importance of the shapes of the molecules involved in the reaction and the formation of the enzyme-substrate complex.

3. Discuss the effects of varying concentrations of enzyme and inhibitor on the overall reaction rate. Include in the discussion the possibilities of having more than one inhibitor molecule per enzyme and of each inhibitor having an optimum concentration.

4. Tell the students that the program they are about to use allows them to design their own experiments using the enzyme acetylcholinesterase and various inhibitors. Tell the students that they should plan their experiments carefully, including a control and keeping track of all variables so that their results will be scientifically acceptable. Review proper scientific experimental protocol.

5. Remind the students of the proper methods for handling diskettes and tell them to insert the diskette into drive A and boot the computer. NOTE: The instructor should make certain that the diskettes have already had the proper DOS commands copied onto them.

6. Instruct the student to follow the on-screen commands and read the on-screen instructions. They should keep a written account of the experiments they run and their outcomes.

7. This program can be run for variable lengths of time depending upon the number and design of the experiments. You MUST preview the program and decide for yourself how much time you will need and the extent of the experiments you wish your students to perform.

8. After allowing the students the appropriate amount of time the students should be instructed to remove the diskettes from the computer and to turn off the computer and the monitor.

Summary:

1. What are enzymes?
2. What is the accepted theory for enzyme action?
3. Why are enzymes essential for life?
4. What is an inhibitor?
5. How do inhibitors function?
6. What factors affect the level of inhibition?

Homework:

1. Explain the lock-and-key model of enzyme action.
2. Describe how enzyme action is influenced by the presence of an inhibitor.
3. If enzymes did not act as catalysts, what consequences would this have for a cell?
4. Explain how inhibitors function.

Enrichment:

Design an enzyme and its corresponding substrate. Include a description of its function in a cell and why it is necessary for the life of the cell. Include at least two inhibitors and explain how they work and which one would be a better inhibitor.

TOPIC 15
Photosynthesis

Aim: How can we demonstrate the conditions under which photosynthesis will occur?

Performance Objectives: Student will be able to:

- describe an experiment that demonstrates the need for chlorophyll in photosynthesis
- show evidence of an understanding that photosynthesis requires light
- explain the photosynthesis reaction including the reactants and the products formed

Materials:

- IBM computer lab
- software: Photosynthesis and Light, CCM
- water bath, alcohol, bunsen burner, Lugol's iodine solution
- a conventional and a variegated leaf for experiment # 1
- geranium plant, one leaf of which is covered with black paper for experiment #2
- overhead projector and transparency of the photosynthesis reaction

Do Now:

Why is the process of photosynthesis necessary for all green plants?

Motivation:

Display a plant. Ask: "What conditions are necessary for the survival of the plant?" "What raw materials must it have available in order to perform its life functions?"

Development:

1. Elicit from the class that a green plant is a chemical factory that changes inorganic substances such as carbon dioxide and water, to organic substances such as carbohydrates by means of photosynthesis.

2. Demonstrate the chemical equation for the reaction by means of an overhead transparency.

3. With a student assistant, remove the chlorophyll from both a conventional and a variegated leaf of a geranium plant.

4. Note the differences in the coloration of both leaves. Elicit the reasons for the difference. Have the students conclude that only the parts of the leaves that contained chlorophyll turned blue-black and that chlorophyll helped the leaf produce starch.

5. Demonstrate a geranium plant that has been exposed to light for several hours.

6. With a student assistant remove two leaves: one, half-covered with black paper and a conventional leaf. Remove the chlorophyll from both and test for starch with Lugol's iodine solution. Have the class observe the differences and conclude the need for light in photosynthesis.

7. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

8. When the menu appears on the screen, instruct the students to select option 1 - Light and Energy. Then have students escape to the main menu and select option 2 - Variables and Controls. This will review the material which was introduced previously in class and during the motivation exercise.

9. The computer-directed instruction starts with a series of screens that define the term photosynthesis and present the word equation for photosynthesis. In option 2 the students observe an experiment which demonstrates what would happen if a plant did not get light.

10. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained information screen. Suggested time is 10-15 minutes. Instruct the students to stop the program at the end of the information screen, to remove the disc from the machine, turn off the computer, monitor and power switches.

Summary:

1. How can we prove the need for chlorophyll in photosynthesis?
2. Why can you conclude from today's experiments that photosynthesis requires light?
3. What essentials are necessary for a plant to carry on photosynthesis?
4. What substances are produced by a green plant during the process of photosynthesis?

Homework:

1. Draw the word reaction for the process of photosynthesis.
2. Read the appropriate section on photosynthesis in your textbook and write the chemical reaction for the process.
3. How does the black paper clipped to the geranium leaf in experiment #2 today, prove the need for light in photosynthesis?

Enrichment:

1. Determine the correlation between the abundance of foliage near the equator and its absence in the high latitudes in terms of the photosynthetic process.
2. If given the following materials, devise an experiment that would illustrate the release of oxygen by a green plant during photosynthesis: elodea, a ring stand and clamp, a test tube and funnel, a glass beaker and water, and a source of light. A duplicate setup is available with black paper.

TOPIC 16
Photosynthesis as an Energy Source

Aim: What is photosynthesis?

Performance Objectives: The students will be able to:

- define the term photosynthesis
- state the general equation for photosynthesis
- explain the role that light plays in the process of photosynthesis

Materials:

- MS-DOS-based computer laboratory
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Light, Plants and Photosynthesis: Energy in Conversion by IBM (also available from Classroom Consortia Media, Inc.)
- several house plants or charts of various members of the plant kingdom

Do Now:

Why do all living organisms require a source of energy?

Motivation:

Show the class several examples of house plants that they may be familiar with: spider plants, cacti, begonia, etc. Ask the students: How do plants get the energy they need to carry on their everyday life activities?

Development:

1. On the board write down several of the student responses to your motivational question. Explore the various answers offered by the students. Guide them to understand that plants need a source of energy (food) and oxygen to perform their everyday functions.

2. Explain to the class that the oxygen is obtained from the air that surrounds each plant. Challenge the students to describe the source of the food that the plants use. (You may discover that several students are familiar with the concept of photosynthesis from exposure in previous grades.)

3. Again guide the class to understand that plants make their own food. This food making process is called photosynthesis. Photosynthesis requires carbon dioxide and water, plus a source of energy, to produce food. Some students will say that they give "plant food" to their plants on a regular basis. Inform the students that this food is composed of chemicals that are normally in the soil. The plants need these chemicals to perform several vital functions. However, these chemicals do not provide the energy needed for "respiration."

4. At this time explain to the students that you are about to help them gain a more complete understanding of the process of photosynthesis with the aid of computers.

5. Remind the students of the basic procedures of computer operation. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up (load). This software package is self-loading. The program commences with a title screen displaying the IBM logo and then proceeds to a menu. Instruct the students to press the #1 key on top of the keyboard to enter the section of the program titled: Light as Energy for Plants.

6. Allow the students 15-20 minutes to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point. After this message, the software goes on to discuss material not covered in this lesson. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Explain photosynthesis.
2. What chemical reaction is involved in the process of photosynthesis?
3. Why is light a vital component of the process of photosynthesis

Homework:

1. Define photosynthesis.
2. State the chemical equation of photosynthesis?
3. What role does light play in the process of photosynthesis?
4. What is the actual food that the process of photosynthesis produces?
5. What two by-products are produced during the process of photosynthesis?

Enrichment:

1. Make a chart showing raw materials and products of photosynthesis.

2. Why do plants need minerals from the soil to perform their daily life functions?

3. In which phyla do we classify the organisms which use photosynthesis to produce food?

4. Do any fungi use photosynthesis to produce food?

TOPIC 17
The Need for Light in Photosynthesis

Aim: What are the results of preventing light from reaching a portion of a leaf?

Performance Objectives: The students will be able to:

- develop a simple experiment to show that light is necessary for the production of food in leaves
- explain the importance of controls in experiments
- explain the effect of variables in experiments

Materials:

- MS-DOS-based computer laboratory
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Light, Plants and Photosynthesis: Energy in Conversion - by IBM (also available from Classroom Consortia Media, Inc.)

Do Now:

What would happen to a plant if you tried to grow it in a dark room? Why?

Motivation:

Ask the class what would happen to a leaf if light was prevented from reaching a portion of that leaf. What experiment could we develop to answer this question?

Development:

1. Elicit several suggestions from the students and explore the implications of these suggestions.

2. Point out that on the surface, this would seem to be a simple experiment. Explain to the students that it is all too easy to develop an experiment, which when closely analyzed, will prove to be worthless.

3. Introduce the term experimental variable. Point out to the students that a scientist should try to foresee all the variables before commencing an experiment.

4. Describe to the class the simple experimental procedure necessary to solve the question raised in the motivational question.

5. Ask the class to find as many variables as possible in this simple experimental procedure. Begin to discuss several of the student answers. After a short period of time, introduce the term controlled experiment.

6. At this time explain to the students that with the aid of computers they are about to proceed with this experiment. The experiment will be performed on the computer, where the numerous conditions and variables

can be observed more easily and rapidly.

7. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk based software. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up (load). The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a menu. Instruct the students to press the #2 key on top of the keyboard to enter the section of the program titled: Variables and Controls.

8. Allow the students 15-20 minutes to operate and explore the program. At the completion of this computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Why are controls necessary in experiments?
2. What is meant by a controlled experiment?
3. What were some of the variables encountered in the experiment conducted on the computer?
4. How can variables affect an experiment?

Homework:

1. Describe the experiment that you performed on the computer to show that leaves require light to make food.
2. What were the variables in this experiment?
3. What is meant by a controlled experiment?
4. How can variables affect the results of an experiment.

Enrichment:

1. Devise an experiment to prove that water is necessary for plant growth. What variables will you encounter? What will your control be?

2. Perform the experiment on a plant, at home, that you conducted with the aid of the computer. Bring the control leaf and the leaf that was partially covered to your teacher so they may be tested for the presence of starch.

3. Describe the procedure that is used to test for the presence of starch in a leaf.

4. Do some research into historic experiments. Have any of the conclusions of these experiments proved invalid because of variables that were not foreseen at the time?

TOPIC 18
Light Waves and Photosynthesis

Aim: Which wavelengths of light are used during photosynthesis?

Performance Objectives: The students will be able to:

- describe the basic properties of light
- state that chloroplasts absorb blue and red light
- state that chloroplasts reflect green light
- describe a euglena
- describe how the colors of the spectrum influence the growth rate of euglenas

Materials:

- MS-DOS-based computer laboratory
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Light, Plants and Photosynthesis: Energy in Conversion by IBM (also available from Classroom Consortia Media, Inc.)
- chart or model of a euglena

Do Now:

Why do plants often grow better with sunlight than under electric lights?

Motivation:

Ask the student if different colored light sources have any effect on photosynthesis? Can they devise a simple experiment to answer this question? How could the effect on photosynthesis be measured?

Development:

1. Discuss with the class the importance of determining a method for measuring an effect on the process of photosynthesis.

2. Review with the class the basic properties of light:
   - objects appear to be the color of the light they reflect
   - light which is not reflected is absorbed by the object
   - white light is composed of the full spectrum of colors

3. Show the chart or model of a euglena to the students. Briefly describe some of the structure and characteristics of the euglena. Be sure to point out that it contains chloroplasts and uses photosynthesis to produce its own food.

4. Ask the students if they can think of a procedure involving euglena that would determine the effects of different colored lights on photosynthesis. Can the fact that euglena reproduce faster under favorable conditions be used to construct an experiment? Explore several of the students' suggestions.

5. At this time explain to the students that with the aid of computers they are about to see one experiment that will determine the effect that lights of different colors have on photosynthesis. The experiment will be performed on the computer, where the numerous conditions and variable can be observed more easily and rapidly.

6. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up (load). This software package is self-loading.

7. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a menu. Instruct the students to press the #4 key on the keyboard to enter the section of the program titled: Wavelengths of Light Used by the Chloroplasts. Allow the students a reasonable amount of time to operate and explore the program.

8. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the computer activity at this point. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Which color (wavelength) of light do chloroplasts absorb?
2. Which color (wavelength) of light do chloroplasts reflect?
3. What characteristics of the euglena make it a good organism for this experiment?
4. What is a controlled experiment?
5. Which wavelength or color of light is most favorable for the process of photosynthesis?

Homework:

1. Complete the answer sheet associated with this lesson.

Enrichment:

1. How do different groups of scientists classify the euglena? Historically, how was the euglena classified.

2. Several companies sell lights labelled as plant lights. Can you find out which wavelengths of light each bulb produces?

3. Can you devise a simple experiment to determine which commercially available "plant light" is most effective?

WORKSHEET — Light Waves and Photosynthesis

Name ____________________ Class ______________ Date ________

Part I - Draw a euglena in the space below. Label the cell membrane, chloroplasts, vacuole, nucleus and flagellum.

Part II - Completion questions

1. An object appears the color of the light it __________.

2. ___________ and ___________ light are most favorable for photosynthesis.

3. ___________ and ___________ light are least favorable for photosynthesis.

4. The _____________ is the organ of locomotion in a euglena.

5. The ______________ of the euglena enable it to make its own food.

6. Euglena are members of the _____________ phylum.

7. The experiment you saw relied upon the euglena's rate of _____________ to determine the influence of colored light upon photosynthesis.

8. The variable factor in the experiment was the _____________________.

TOPIC 19
Light and Dark Phases of Photosynthesis

Aim: What are the two phases of photosynthesis?

Performance Objectives: The students will be able to:

- write the balanced equation explaining photosynthesis
- describe the light phase of photosynthesis
- describe the dark phase of photosynthesis
- explain how the substances needed for photosynthesis enter the plant.
- describe the role of the chloroplasts in photosynthesis
- Name the waste products of photosynthesis

Materials:

- MS-DOS-based computer laboratory
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Leaf - Structure and Physiology - by IBM also available from Classroom Consortia Media Inc. under the title of Leaf: Structure and Function
- model of a typical leaf in cross-section
- worksheet associated with this lesson

Do Now:

Describe the process of photosynthesis. Name and describe the structures found in green plants which perform photosynthesis.

Motivation:

Show the students the model of a leaf in cross section. Remind the class that have learned that green plants make their food through a process called photosynthesis and that photosynthesis takes place in the leaves. Challenge the students to describe the process of photosynthesis and to indicate exactly where in the the leaf photosynthesis takes place by reviewing the student responses to the 'Do Now.'

Development:

1. Elicit from the class several answers to the motivational question.

2. Most of the students will be familiar with the concept of photosynthesis from previous classes. However, few will know the details of the chemical reactions involved in the light and dark phases. Guide the class to understand that water and carbon dioxide are the raw materials used in photosynthesis. Explain to the students that these starting materials are converted, with the assistance of energy, to a simple carbohydrate called glucose (simple sugar, a monosaccharide).

3. Tell the students that photosynthesis is a two-stage reaction. The two stages are called the light phase and the dark phase. Ask the students if they can guess the implications of these names.

4. Elicit from the students that the light phase can take place only in the presence of light. It requires light as a source of energy.

5. Guide the students to understand that the dark phase of photosynthesis does not require light. However, the dark phase may proceed whether or not light is available.

6. At this time explain to the students that with the aid of computers you are about to present them with a deeper understanding of the complex process of photosynthesis. The chemical equation representing photosynthesis will be covered as well as the reactions occurring during the light and dark phases.

7. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software by telling the students not to bend the diskettes. Instruct the students to press the #3 key on top of the keyboard to enter the section of the program: Photosynthesis and the Leaf.

8. Allow the students 10-15 minutes to operate and explore the program. The students will be quizzed at several points during the progress of this program. If students do not respond correctly to the questions, the program will supply hints to aid the students. If the students require more than two tries to answer a question, the program will supply the answer. At pivotal points of the program, the students will be offered an opportunity to repeat sections of the program if two or more incorrect responses are detected.

9. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the computer lesson at this point.

10. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. What is the balanced chemical equation representing photosynthesis?
2. What reactions occur during the light phase of photosynthesis?
3. What reactions occur during the dark phase of photosynthesis?
4. What are the raw materials needed by the leaf in order for photosynthesis to occur?
5. What is the role of chlorophyll in photosynthesis?
6. Which two waste products are formed during photosynthesis?

Homework:

1. Complete the worksheet associated with this lesson.

Enrichment:

1. Make a chart comparing the light and dark phases of photosynthesis.
2. Devise an experiment to demonstrate that plants produce water as a waste product during photosynthesis.
3. Research the progress that scientists have made in trying to duplicate the process of photosynthesis in "test tubes".
4. Write an imaginative essay on how your life would change if scientists were able to duplicate the process of photosynthesis.

WORKSHEET — Light and Dark Phases of Photosynthesis

Name ________________________ **Class** ________ **Date** __________

Part I - In the space provided below, write the balanced chemical equation representing photosynthesis.

Part II - Completion questions

1. Photosynthesis occurs in green plants that contain the chemical ________________________.
2. Chlorophyll is a __________ color chemical.
3. The energy of the light is captured by the ____________________ in certain plant cells.
4. The energy is eventually stored as chemical _______ energy in the glucose molecule.
5. Photosynthesis takes place in the _______________ cells and ________________ layers inside the leaf.
6. Photosynthesis consists of a ________ phase and a _______ phase.
7. During the ______ phase, water molecules are split with the air of energy from light.
8. During the _________ phase, hydrogen combines with carbon dioxide to form _______________.
9. The gases needed for photosynthesis enter the plant via __________________ on the underside of the leaf.
10. _______________ and _____________ are waste gases of the process of photosynthesis.
11. ________________ is the movement of water from the interior of the leaf to the atmosphere.
12. Some of the food produce by photosynthesis is transported to the other parts of the plant via the ___________.

TOPIC 20
Adaptations for Nutrition in Plants

Aim: What adaptations permit a plant to obtain its food?

Performance Objectives: Students will be able to:

- explain the significance of the formula for photosynthesis
- explain the significance of the "light" and "dark" reactions
- describe the raw materials required for photosynthesis
- describe the role of chloroplasts in photosynthesis
- identify the parts of the leaf which are essential to photosynthesis
- describe the relationship between transport within the plant and the process of photosynthesis

Materials:

- MS-DOS computer lab, color monitors
- software: Exploring That Amazing Food Factory, The Leaf by Thoroughbred Educational Software, Disk #2
- an assortment of green plants
- one of more carnivorous plants (Venus Fly Trap, Pitcher Plant, etc.)
- examples of fungi mushrooms or bread mold
- a package of "plant food"

Do Now:

List the functions exhibited by all living organisms.

Motivation:

Display the green plants and ask the students: What do these plants eat? The teacher should elicit student responses and then remind the students that "nutrition" is one of the seven life functions and plants must have a source of nutrients in order to provide them with the energy necessary to perform the other life functions.

Ask the students: What would happen to this plant if it was placed in a dark closet for several weeks? Why? The teacher should elicit that green plants use the process of photosynthesis to produce food from sunlight. Introduce the word "autotroph" and assist the students in developing the concept that green plants are "autotrophic" or self-feeders. They manufacture glucose from raw materials. Sunlight provides the energy for this chemical process.

Display the carnivorous plant and describe or demonstrate its ability to catch insects? If this plant was given an adequate supply of insects can it grow in the dark? The teacher should elicit that this is a green plant that performs photosynthesis and describe the conditions in which this type of plant is found. Carnivorous plants have adapted to survive in mineral poor soils and the digested insects provide the plant with minerals that are not available in the soil.

Development:

1. Introduce the formula for photosynthesis and place it on the blackboard. Explain the process of photosynthesis and introduce the students to the "light" and "dark" reactions. The students must be informed that both of these reactions occur when the plant is in the light. The "light" reactions make direct use of the incoming sunlight. The light energy is trapped by the chlorophyll and is used by the structures within the leaf to split water into hydrogen and oxygen. The "dark reactions do not make direct use of light. They use ATP that was produced during the light reactions as a source of energy to synthesize glucose out of the hydrogen (from the water) and the carbon dioxide. The teacher should introduce the students to the formula for glucose.

2. What do plants require in addition to sunlight and water? Direct the students back to the carnivorous plant and also display the bag of plant food. You may have one of the students read the contents of the fertilizer. Plant foods contain various ratios of nitrogen and minerals. Most green plants obtain these minerals from the soil and absorb them through the root hairs. Plants that are found in mineral-poor regions may have specific adaptations. The carnivorous plants are examples of this special adaptation.

3. What is the source of nutrition for non-green plants? The teacher may wish to display a mushroom, a piece of fungus from a tree, or a sample of moldy bread. The teacher should explain that these are non-green plants that do not perform photosynthesis. They are heterotrophs that must obtain food from an outside source. They must take in preformed organic molecules from other living or dead organisms. The teacher should introduce the terms saprophyte and parasite.

4. Review the material that was just taught and explain to the students that photosynthesis is the major source of nutrition for green plants. The teacher should introduce the computer activity and inform the class that they will use the computers to learn about the special adaptations in plants that permit them to perform photosynthesis.

   PRIOR TO THE FIRST USE OF THIS PROGRAM THE TEACHER SHOULD PREPARE SELF-LOADING DISKS. THIS REQUIRES THAT THE TEACHER TRANSFER A COPY OF DOS (DISK OPERATING SYSTEM) ONTO EACH OF THE PROGRAM DISCS. THE INSTRUCTIONS FOR THIS PROCESS ARE CLEARLY EXPLAINED IN THE DOCUMENTATION. THE TEACHER SHOULD ALSO PREPARE A BACKUP COPY OF EACH OF THE PROGRAM DISKS AND STORE THE ORIGINAL PROGRAM DISK AS AN ARCHIVE COPY.

   Distribute the software. If the students are not familiar with the operation of the computers inform them that they should not bend or fold the disks and should not place anything but the diskettes into the disk drive.

5. Instruct the students to insert the program disk #2 into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. If DOS was placed on the program disks they will self-load and the students will be presented with the title screen and a menu.

6. If the students have not used this software previously instruct the students to select section #1 - Exploring New Ideas. This short segment introduces the students to the key concepts and vocabulary used within the program. A scrambled message must be decoded after the vocabulary words have been learned. This approach challenges the students to learn the vocabulary.

7. Instruct the students to press "ESC", the escape key, after they complete the introductory segment. This will return the program to the menu. Instruct the students to select section 11 - Photosynthesis and the Leaf. The students should be given approximately 15-20 minutes to complete this activity.

8. The computer software will provide the students with an explanation of photosynthesis and introduce the students to the formula for photosynthesis. The software DOES NOT discuss the light and dark reactions. The students are then introduced to the chloroplasts and the role of the chloroplasts in the process of photosynthesis. The software then provides the students with a chart of the materials required for photosynthesis and the products that result from the chemical reactions. The information is presented with explanations and animated graphics.
   a. Prior to this activity, the students should have studied the structures of the plant leaf or completed Disk #1 section 11 "The Structure of the Leaf". This program introduces the students to the leaf cross section, the structures in plant cells and reviews the adaptations for transport in plants.

9. Instruct the students to test themselves using the segment "Measuring Your Progress" which follows the instruction. When the students have finished the quiz they should press "ESC" to end the activity and return to the menu.

10. At the conclusion of the computer activity, instruct the students to place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers and monitors.

Summary:

1. What adaptations assist a green plant in obtaining minerals?

2. What is the source of glucose in green plants?

3. What is the difference between autotrophic plants and heterotrophic plants?

4. What structures within the leaf permit a plant to perform photosynthesis?

5. What are the functions of the chloroplasts?

6. How do the root hairs and other adaptations for transport assist a green plant in providing materials necessary for photosynthesis?

Homework: Use your biology textbook to help you complete this assignment.

1. Write a short report on the process of photosynthesis. Discuss the adaptations that permit green plants to manufacture glucose directly from raw materials with energy captured from sunlight.

Enrichment:

1. Investigate the processes used by plants to store nutrients. What is the relationship between glucose and starch?
2. How do deciduous plants survive through the winter when they lose their leaves.

TOPIC 21
Passage of Materials Through Cell Membranes

Aim: How does the cell membrane control the flow of molecules in and out of the cell?

Performance Objectives: Students will be able to:

- define the following terms: diffusion, passive transport, and selectively permeable
- explain why some membranes are selectively permeable

Materials:

- IBM computer lab
- software: Passive Transport by Classroom Consortia Media, Inc.
- materials for demonstrations as shown below
- Lugol's iodine, Benedict's solution for sugar and starch tests

Do Now:

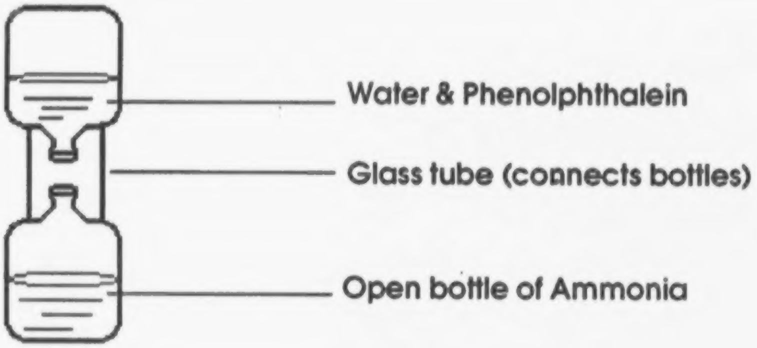
What would happen to a living cell if its outer covering was impervious to water and other substances?

Motivation:

Show an overhead transparency of a typical cell. Elicit the need for materials to flow in and out of the cell. How is this flow of materials controlled by the cell?

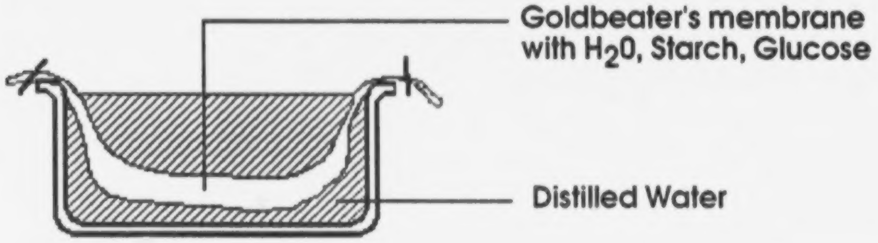
Development:

1. Develop the concept that molecules are in a constant state of motion by opening a small bottle of ammonia. Have students note the odor in different parts of the room.
2. Elicit from class the concept of diffusion in that molecules move from areas of greater to lesser concentration.
3. Show an overhead transparency of a cell. Identify the cell membrane.
4. Demonstrate that only molecules of certain sizes can pass through the cell membrane.



5. Elicit the function of the cell membrane as that of selectively controlling the flow of molecules in and out of the cell. Elicit the definition of selective permeability. Relate it to the size of molecules that can and cannot enter and leave the cell.

6. Demonstrate passive transport and elicit its meaning from the class. Show the following demonstration that had been previously set up and tested for the presence of nutrients. Have the class recall that sugar and starch mixtures were originally only in the Goldbeater's membrane sac which represents a "cell membrane".



7. Elicit from the class that simple sugar (glucose) molecules are much smaller than those of starch. Test the distilled water for the presence of starch and sugar. Have the class predict which substances, if any, are to be found in the beaker of distilled water. Lead the class to determine the meaning of the term "selectively permeable."

8. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

9. When the menu appears on the screen, instruct the students to select option 3 - Transport Through a Membrane. This will review the material which was introduced in class and during the motivation exercise.

10. The computer-directed instruction starts with an animation of transport through a membrane. Subsequent screens define cell membranes as being selectively permeable and show molecules moving through their "pores". An interactive experiment answers the question as to how molecular size affects diffusion through cell membranes. A final screen reviews porosity and diffusion.

11. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained information screen. Suggested time is 10-15 minutes. Instruct the students to stop the program at the end of the review screen, to remove the disk from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers carefully without touching the recording surface.

Summary:

1. How would you describe the term diffusion?
2. What is meant by passive transport in a cell?
3. Why must certain cells be selectively permeable?
4. Explain why some membranes are selectively permeable and others not?

Homework:

1. Define the terms passive transport and diffusion.
2. Construct a graph which illustrates the number of molecules that diffuse from an ammonia bottle in 20 seconds.
3. Explain how certain size molecules are able to pass through a semi-permeable membrane. Use diagrams if needed.
4. Explain why the starch was not found in the beaker in today's experiment.

Enrichment:

1. Research the answer to the following question and report back to the class: How does diffusion differ from osmosis?

2. Investigate the fluid-mosaic model of the cell membrane. Explain what is meant by a scientific model. Why was this model developed? Haw does it differ from the explanation of semi-permeable membranes which was studied in class?

TOPIC 22
Diffusion

Aim: How does diffusion occur?

Performance Objectives: Students will be able to:

- define diffusion
- understand a concentration gradient
- explain how equilibrium is achieved
- explain what is meant by a semi-permeable membrane
- relate the structure of the cell membrane to the passage of various types of substances through the membrane

Materials:

- IBM computer lab
- software: Passive Transport: Diffusion and Osmosis by IBM Software

Motivation:

Place a large bottle of ammonia at the front of the classroom. Before the class begins open the bottle. When the students have come in and seated themselves they will probably begin to complain about the odor.

Ask the students to identify the odor. Ask them what the source of the odor is. Ask them if they are able to explain how the students at the back of the room are able to smell the ammonia. The students will probably be familiar with the term diffusion, ask them if they can explain the mechanism behind diffusion, or

"How does diffusion occur?"

Development:

1. Discuss the concept that the smell of the ammonia at the back of the classroom is due to the physical presence of ammonia molecules at the back of the classroom. Introduce the concept of molecules being in constant motion.
2. Introduce the concept of concentration gradients and the passive flow of molecules from an area of high concentration to an area of low concentration.
3. Define equilibrium and discuss the factors involved in achieving equilibrium.
4. Introduce the concept of diffusion through a membrane. Discuss semi-permeable membranes and the abilities of different molecules to pass or not to pass through them.
5. Remind the student of the correct method for handling diskettes and tell them to insert the diskette into drive "A" and then turn on the computer and the monitor.

6. When the menu appears they should choose option #1. When they complete option 1 they should continue and complete options 2 and 3 also. When they have finished option 3 they should quit the program.

7. Allow the students approximately 20 - 25 minutes to complete the program. Instruct the students to remove the diskette from the computer and turn of the computer and the monitor.

Summary:

1. What is meant by the term diffusion?
2. Why is diffusion considered a form of passive transport?
3. What is a concentration gradient?
4. When is equilibrium reached?
5. What is meant by a semi-permeable membrane?
6. What determines whether a substance can pass through a membrane?

Homework:

1. Define the following terms:
    a) concentration
    b) diffusion
    c) equilibrium
    d) passive transport
    e) permeable
    f) semi-permeable

2. Explain why passive transport does not require any energy.

3. Explain how diffusion is dependent on a concentration gradient.

Enrichment:

1. Obtain and prepare three different semi-permeable membranes which are permeable to different molecules. Place them in three different solutions and describe which molecules pass through each membrane and why.

TOPIC 23
Diffusion in Cell Membranes

Aim: How can diffusion move molecules from one location to another?

Performance Objectives: The students will be able to:

- describe the random motion of molecules
- define equilibrium
- describe the diffusion of molecules
- define passive transport
- interpret a graph depicting diffusion vs. time

Materials:

- MS-DOS-based computer laboratory
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Passive Transport: Diffusion and Osmosis by IBM
- bottle of fragrant substance e.g. perfume

Do Now:

The sense of smell can protect humans from danger. Describe a situation in which the presence of a hazardous condition can be detected by smell.

Motivation:

Open a bottle of perfume water or other fragrant substance (the windows and door of the class should be closed). In a little while, the students will begin to notice the fragrance filling the room. Ask the students how the aroma of the perfume traveled from the bottle to their noses.

Development:

1. Elicit from the class several answers to the motivational question.

2. Remind the students that the nose identifies aromas when molecules enter and stimulate the olfactory organs in the nasal passage.

3. Guide the students to understand that some of the molecules from the bottle have reached the nose.

4. Some of the students may venture to say that stray air currents have carried the molecules to the nose. Tell them that they're probably partially correct. However, it is doubtful that air currents would have entered the bottle.

5. At this point, introduce the students to the concept of diffusion. State that diffusion is the process whereby molecules move from an area where they are in high concentration to an area of lower concentration.

6. At this time explain to the students that with the aid of computers you are about to help them obtain a better understanding of the process of diffusion and the related concept of equilibrium.

7. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a screen identifying the program. In a few moments the menu to this program is revealed. Instruct the students to press the #1 key on top of the keyboard to enter the section of the program: Process of Diffusion.

8. Allow the students 15-20 minutes to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point. After this message, the software goes on to discuss material not covered in this lesson.

9. At the completion of the computer guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Describe the motion of molecules.
2. How can water molecules of different substances differ from each other?
3. Define diffusion.
4. What is meant by passive transport?
5. Describe the concept of equilibrium.

Homework:

1. Make a diagram illustrating the concept of diffusion.
2. Define passive transport.
3. Define diffusion.
4. Define equilibrium.
5. Give several examples of diffusion.

Enrichment:

1. Make a diagram illustrating the concept of equilibrium.

2. Make a graph illustrating the results of diffusion vs. time.

3. Do you think that diffusion can occur in solids. Write a short report answering the question and stating your reasons.

TOPIC 24
Selective Permeability

Aim: What is selective permeability?

Performance Objectives: The students will be able to:

- state that all living cells have cell membranes
- define selectively permeable
- describe a typical cell membrane
- explain how a permeable membrane controls the passage of molecules
- describe the fluid mosaic of a cell membrane

Materials:

- MS-DOS-based computer laboratory
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Passive Transport: Diffusion and Osmosis by IBM
- worksheet associated with this lesson

Motivation:

Challenge the students to explain how molecules pass through a cell membrane.

Development:

1. Elicit from the class several answers to the motivational question. Lead the students to understand that membranes act as though there are small holes or passages which are smaller than some of the molecules surrounding the cell. Introduce the fluid mosaic model of the cell.

2. Steer the students to understand that only those molecules that are smaller than the pores may enter the cells. Inform the class that the terms selectively permeable and semi-permeable cover this concept. Note: The software does not include the fluid mosaic model.

3. Ask the students to explain which molecules would go through the membrane. Use starch and sugar as examples: Starch, a disaccharide, cannot pass through the membrane, yet after digestion the resulting glucose (a monosaccharide) can pass through the membrane.

4. Guide the students to recall that diffusion will cause molecules to move from an area of high molecular concentration to an area of lower concentration.

5. Explain to the students that you will help them obtain a better understanding of how molecules are transported through semi-permeable cell membranes. The concept of equilibrium will also be explored.

6. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to load. This software package is self-loading.

7. The program commences with a blue screen displaying the IBM logo and then proceeds to a menu. Instruct the students to press the #2 key on the keyboard to enter the section of the program: Transport Through a Membrane.

8. Allow the students a reasonable amount of time to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Describe the cell membrane of a typical cell.
2. Define the term selectively permeable.
3. What prevents larger molecules such as starch from passing through a cell membrane?
4. Why do some molecules pass through cell membranes?
5. What governs the direction in which the molecule moves.

Homework:

1. Complete the worksheet associated with this lesson.

Enrichment:

1. Research the size and shape of several molecules. Make several drawings representing these molecules.

2. Does passive transport require energy? Explain your answer.

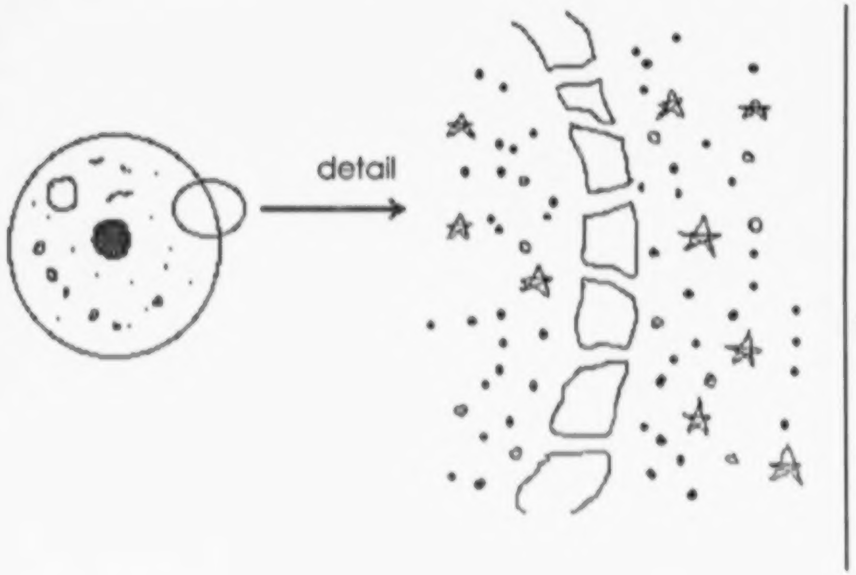
3. Name some molecules that might normally enter a human blood cell. Name some molecules that would normally be found exiting a human blood cell.

4. Why did scientists develop the fluid mosaic model of the cell membrane? What is a scientific model?

WORKSHEET — Selective Permeability

Name ________________________ **Class** ________ **Date** __________

Part 1 - Below is a drawing depicting a cell membrane and various molecules before diffusion occurs. Indicate with arrows the direction of the molecular movement. Circle the molecules which will not pass through the membrane.



Movement

○ ____________

■ ____________

☆ ____________

Part II - Completion Questions

1. All living cells have a cell ________________.
2. The cell membrane of living organisms is ____________ permeable
3. The cell membrane of plants is surrounded by a ______ __________.
4. Two types of molecules that normally enter the cell are molecules of ________ and ________.
5. Molecules of __________ substances exit the cell.
6. Molecules vary in ________ and _________.
7. __________________ is the driving force for the passage of molecules through the cell membrane.
8. Molecules that are _____________ than the pores cannot enter the cell.
9. For molecules to enter the cell, the molecules must be __________________ than the _________ of the cell membrane.
10. _________ is an example of a molecule which can enter a typical cell.

TOPIC 25
Diffusion, Permeability and Osmosis

Aim: What experiments can we conduct to illustrate the concepts of diffusion, equilibrium, and osmosis?

Performance Objectives: The students will be able to:

- explain why glucose will diffuse through a selectively permeable membrane into a suspension of starch
- explain how solutions of amino acids and glucose separated by a membrane permeable to both will achieve a state of equilibrium
- define osmosis
- explain why osmosis causes distilled water to enter a molasses through a selectively permeable membrane.

Materials:

- MS-DOS-based computer laboratory
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Passive Transport: Diffusion and Osmosis by IBM

Do Now:

What is a selectively permeable membrane? How do membranes allow the nutrients from food to be absorbed by the body?

Motivation:

Challenge the students to set up experiments to show the principle of diffusion and equilibrium in solutions separated by a selectively permeable membrane. Review the "Do Now" and discuss the student responses.

Development:

1. Ask some students to go to the board and draw the set-up they would require for their experiment.

2. Review each student's work, pointing out the correct points and suggesting changes where necessary. If the students have difficulty designing these experiments (they should have already been exposed to similar experiments during previous lesson about passive transport), guide them to reach the proper results.

3. Tell the students that the term osmosis is used to characterize the diffusion of water molecules through a selectively permeable membrane.

4. At this time tell the students that they are going to participate in three experiments conducted via the computers. The computer experiments will aid them to better understand the concepts of diffusion, osmosis and equilibrium.

5. Remind the students of the basic procedures of computer operation. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up (load). This software package is self-loading. If the computer is already in operation, insert the disk into the proper drive and then while simultaneously holding down the CTRL and ALT keys, press the DEL key.

6. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a screen identifying the program. In a few moments the menu to this program is revealed. Instruct the students to press the 3 key on top of the keyboard to enter the section of the program: Equilibrium and Osmosis.

7. Allow the students a reasonable amount of time to operate and explore the program. The computer program is of a tutorial nature and is highlighted by many outstanding illustrations. The students will be quizzed at several points during the progress of this program. If students do not respond correctly to the questions, the program will supply hints to aid the students. If the students require more than two tries to answer a question, the program will supply the answer. At pivotal points of the program, the students will be offered an opportunity to repeat a section of the program if too many incorrect responses are detected.

8. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Describe an experiment demonstrating the principle of equilibrium. What were the results of the experiment?
2. Describe an experiment demonstrating the principle of osmosis. What were the results of the experiment?
3. Define osmosis.
4. Define dynamic equilibrium.

Homework:

1. Through the use of diagrams, illustrate the experiment demonstrating the principle of equilibrium. Explain the results of this experiment.
2. Through the use of diagrams, illustrate the experiment demonstrating the principle of osmosis. Explain the results of this experiment.
3. Compare the terms diffusion and osmosis.
4. What causes molecules to reach a state of equilibrium?
5. Describe the motions of water molecules in liquid water.

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Enrichment:

1. How does lowering the temperature effect the motion of molecules?
2. Is molasses a true solution? How is molasses made?
3. In the experiment demonstrating the principle of osmosis, what would happen if regular water were substituted for distilled water. If possible, ask your teacher for a semi-permeable membrane and conduct the experiment in your home.

TOPIC 26
The Transport System of a Leaf

Aim: How is the transport system of a leaf constructed?

Performance Objectives: The students will be able to:

- describe the structure and function of the major components of a typical leaf
- describe the structure and function of the xylem
- describe the structure and function of the phloem
- describe a simple experiment to demonstrate transport in a plant

Materials:

- MS-DOS-based computer laboratory
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Leaf - Structure and Physiology.
  also available from Classroom Consortia Media Inc. under the title of
  Leaf: Structure and Function
- model of a typical leaf
- worksheets associated with this lesson

Do Now:

Why must a plant be watered? What parts of the plant absorb the water?

Motivation:

Review student responses to the 'Do Now.' Display leaf cross-section model. Ask the class how water entering the roots of a plant is bought to areas where it is needed. Do plants have circulatory systems? Are any structures in this leaf model adaptations for transport?

Development:

1. Elicit from the class several answers to the motivational question.

2. Show the class the model of the typical leaf. Point out the various components of the transport system. Tell the class that unlike human blood vessels, the veins of a plant do not carry blood. However they are the main components in the transport system of the plant.

3. Challenge the class to describe the various materials that flow through the plants transport system.

4. Elicit from the class that water is not the only material which passes through the plant's transport system. Explain to the students that minerals vital to the survival of the plant also flow through the veins. Point out that some of the food produced in the leaves also flows through the transport system of the plant.

5. At this time explain to the students that with the aid of computers you are about to help them obtain a better understanding of the complex structure and function of a leaf. The purpose and structure of chloroplasts will also be described. Photosynthesis will also be briefly examined.

6. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up (load). The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a menu. Instruct the students to press the #2 key on the keyboard to enter the section of the program: Structure of a Leaf.

7. Allow the students 15-20 minutes to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point.

8. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Name and describe the external structures of a typical leaf.
2. Name and describe the internal structures of a typical leaf.
3. What is the structure and function of a chloroplast?
4. What is chlorophyll?

Homework:

1. Complete the worksheets associated with this lesson.

Enrichment:

1. Make a chart of all the structures of a leaf. Describe the functions of each of these structures.

2. Both the leaf and the human skin have a layer called the upper epidermis. Is there any similarity in structure and function between these two tissues?

3. The underside of leaves have openings called stomata. Is there any similarity between a leaf's stomata and pores in the human skin?

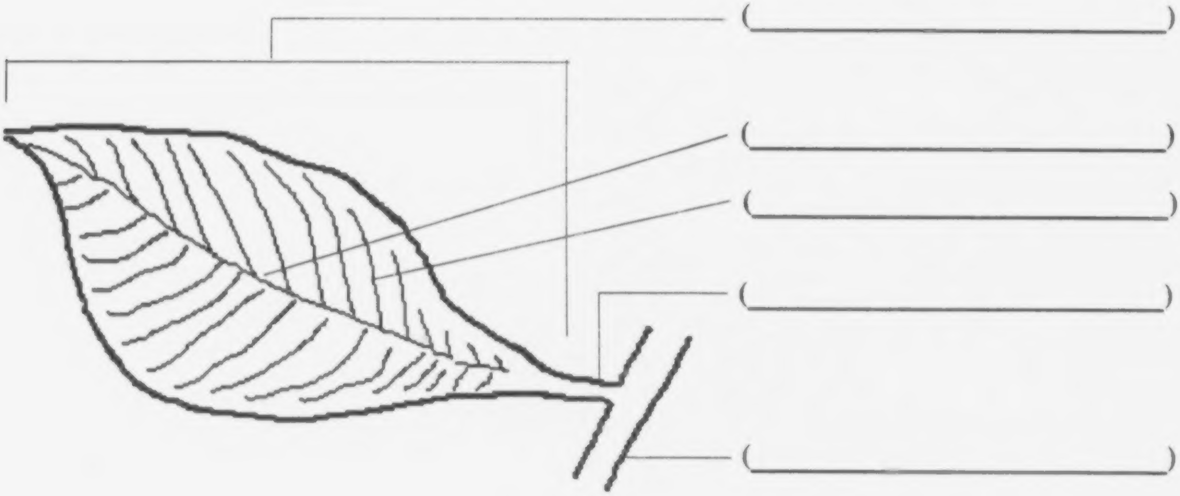
4. Do "higher" plants that live in water have stomata on their leaves?

5. The "needles" of a pine tree are really its leaves. Are these leaves like the typical leaf that you studied in class? If not, in what ways do they differ?

WORKSHEET — The Transport System of a Leaf

Name ________________________ **Class** ________ **Date** __________

Part I - Below is a diagram of a leaf. Fill in the blanks with the correct name.



Part II - Completion

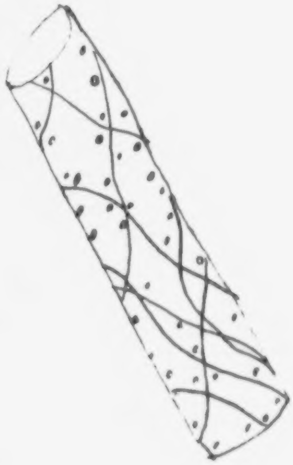
1. The ____________ is the large vein that is located along the center of the leaf.
2. The ____________ attaches the leaf to the stem.
3. The stem serves as a ____________ to the leaf.
4. The large flat, broad area of the leaf is known as the __________.
5. The veins of a plant are composed of groups of small tubes called ____________________________.
6. The ____________ are the veins which are located within the bundles of xylem tissue.
7. A network of ___________ is easily visible on the surface of a typical leaf.

WORKSHEET — The Transport System of a Leaf

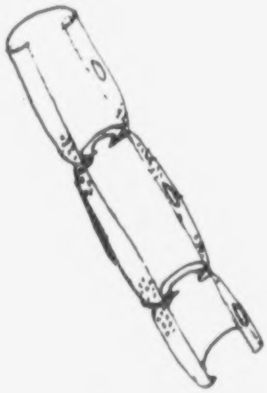
Name __________________________ **Class** ________ **Date** __________

Part I - Below are diagrams of the xylem and phloem. Fill in the blanks with the correct names.

Xylem



Phloem



Part II - Completion questions

1. The ____________ are the veins of the transport system which move food downward for storage.
2. The ____________ are the veins of the transport system which move ___________ and ____________ upward.
3. The _______ cell help in the transport of materials through the xylem.
4. ___________ tissue that is fully developed is dead.
5. Mature xylem tissue have no ______________ and no ______________.
6. _____________ is composed of sieve tube cells.
7. ___________ cells are located near the sieve tube cells.
8. ______________ help regulate the cytoplasm of the phloem.
9. The plants transport system extends from the plants leaves to its ___________.

TOPIC 27
The Structure of a Leaf

Aim: What is the structure of the leaf?

Performance Objectives: The students will be able to:

- describe the internal and external structure of a typical leaf
- name the structures in a leaf cross-section diagram
- explain the function of each component of a leaf
- describe the structure of a chloroplast
- explain the function of chloroplasts

Materials:

- MS-DOS-based computer laboratory
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Leaf - Structure and Physiology - IBM
  also available from Classroom Consortia Media Inc. under the title of
  Leaf: Structure and Function
- model of a typical leaf in cross-section
- worksheets associated with this lesson

Do Now:

Describe the functions of a leaf.

Motivation:

Show the class the model of a leaf in cross-section. Point out the complicated structure of the leaf.

Development:

1. Elicit from the class several answers to the 'Do Now'.

2. Many students may be familiar with the concept of photosynthesis learned in previous classes. Elicit from the students that photosynthesis is the process that enables green plants to produce their own food.

3. Challenge several students to come to the front of the class and indicate on the model where photosynthesis takes place within the leaf.

4. Most students will be baffled by the complexity of the leaf's structure. Explain to the class that the leaf's primary purpose is food production. Explain that it requires many groups of cooperating tissue structures to produce and process the food.

5. Explain to the students that with the aid of computers you are about to help them obtain a better understanding of the structure and function of the transport system found in plants.

6. Remind the students of the basic procedures of computer operation. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a screen identifying the program. In a few moments the menu to this program is revealed. Instruct the students to press the #1 key on top of the keyboard to enter the section of the program concerned with the Transport in a Leaf.

7. Allow the students 10-15 minutes to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point. After this message, the software goes on to discuss material not covered in this lesson.

8. At the completion of the computer guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Describe each of the following plant structures: veins, midrib, petiole, stem.
2. Explain the function of the phloem.
3. What is the function of the xylem?
4. What are the roles of the phloem and xylem in the plant's transport system?
5. What conclusions can be drawn from the experiment that was performed on the computer?.

Homework:

1. Complete the worksheets associated with this lesson.

Enrichment:

1. Make a chart comparing the phloem and xylem.

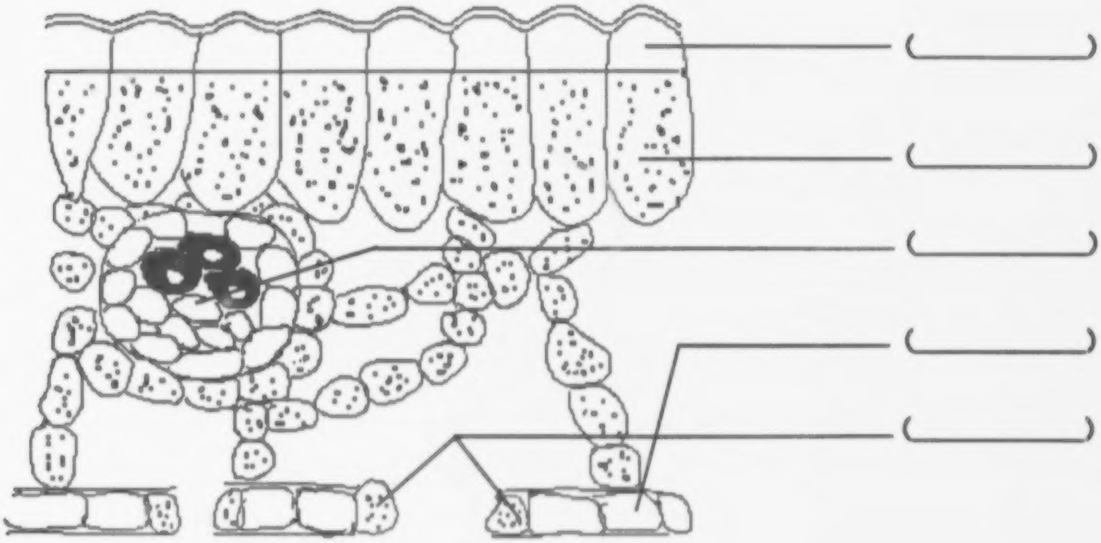
2. Do all the plant phyla have transport systems? If not, which phylum lack a transport system.

3. At home, duplicate the experiment that was demonstrated on the computer. Place a stalk of celery into a glass containing a mixture of red ink and water. What did you observe? Why?

WORKSHEET – The Structure of a Leaf

Name ____________________ Class ________ Date __________

Part 1 - Below is a diagram of a cross section of a leaf. Fill in the names to correctly label the diagram.



Part II - In the space provided below, draw a typical plant cell. Label six parts of the plant cell.

WORKSHEET 1 — The Structure of a Leaf

Name ______________________ **Class** _______ **Date** _________

Part I - In the space provided below, draw a diagram of a chloroplast. Clearly show and label the grana. See if you can accurately represent the lamella.

Part II - Completion questions

1. The __________ layer serves as a waterproofing for the leaf.

2. Both the __________ cells and the __________ cells manufacture food in the leaf.

3. The cells of the upper ____________ provide protection for the cells below it.

4. The _________ cells regulate the opening of the stomata.

5. The ____________ allow gases to pass in and out of the leaf.

6. The ___________ within the leaf allow room for oxygen, carbon dioxide and water vapor.

7. The _________ of the transport system criss-cross the interior of the leaf.

TOPIC 28
The Role of the Stomata

Aim: How do stomata aid in the process of photosynthesis?

Performance Objectives: The students will be able to:

- describe the structure of guard cells and stomata
- explain the conditions responsible for the opening and closing of the stomata
- explain why diffusion of gases into and out of the leaf occurs during photosynthesis

Materials:

- MS-DOS-based computer laboratory
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Leaf - Structure and Physiology. Also available from Classroom Consortia Media Inc. under the title of Leaf: Structure and Function
- model or chart showing the stomata of a leaf
- worksheet associated with this lesson

Do Now:

How does carbon dioxide enter a growing plant?

Motivation:

Show the students the model of the stomata. Challenge the students to describe the function of the stomata.

Development:

1. Elicit from the students several answers to the motivational question. Guide the students to understand that the stomata are "holes" in the underside of the leaf through which gases may diffuse.

2. Ask the class if they can determine where in the leaf the passage through the stomata leads?

3. Again guide the class to recall structures of the leaf's interior learned in previous lessons. Guide the class to conclude that gases diffuse into the air spaces within the spongy layer of the leaf. Ask the class: Why must gases enter and leave the leaf?

4. Elicit from the students that both respiration and photosynthesis require a number of gaseous raw materials. Both processes also produce gaseous waste products. These gases enter and leave the leaf via the stomata.

5. Review the chemistry of photosynthesis with the class.

6. Tell the students that the stomata are capable of controlling the passage of gases. Ask the students if they can guess how this is done.

7. Explain to the students at this time that with the aid of computers you are about to help them obtain a better understanding of the role the stomata play in the process of photosynthesis. The program will show them how the guard cells function to open and close the stomata.

8. Remind the students of the basic procedures of computer operation. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a screen identifying the program. In a few moments the menu to this program is revealed. Instruct the students to enter the section of the program called: Action of the Stomata in Gas Exchange.

9. Allow the students a reasonable amount of time to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to stop working at this point. Have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. What is the function of the stomata?
2. How do changing concentrations of water and glucose control the size and shape of the guard cells.
3. Where do the gases that enter the leaf go?
4. How do the guard cell control the opening of the stomata?
5. Which gases pass through the stomata during photosynthesis?

Homework:

1. Complete the worksheet associated with this lesson.

Enrichment:

1. Make a chart showing how the concentrations of water and glucose in the guard cells control the stomata.

2. Do all plant leaves have stomata? If not, which plants do not have stomata?

3. Do plants in different environments have different concentrations of stomata on their leaves? Do desert plants have more or less stomata then plants growing in rain forests?

WORKSHEET — The Role of The Stomata

Name ______________________ Class _______ Date _________

Part I - In the space provided below, draw 2 pictures of the stomata and guard cells. One picture should depict closed stomata. The other picture should depict open stomata. Label both pictures to show guard cells, stomata opening, chloroplasts and nuclei.

Part II - Completion questions

1. Gases are temporarily stored in the leaf in locations called ________________.
2. During photosynthesis, gases diffuse from the ___________ to the ____________.
3. The _______________ surround the stomata.
4. _______________ are the only cells in the lower epidermis that contain chlorophyll.
5. Stomata normally ___________ during the night.
6. Stomata are usually __________ during the daytime.
7. When the guard cells become turgid, the stomata __________.
8. The comparative concentrations of __________ and __________ control the opening of the stomata.
9. The guard cells become turgid during times of __________ glucose production.
10. Glucose is produced only during hours of ____________.

TOPIC 29
Transport in Plant and Animal Cells

Aim: How do plant and animal cells react in hypotonic, isotonic and hypertonic solutions?

Performance Objectives: The students will be able to:

- define isotonic
- define hypertonic
- define hypotonic
- describe the change in plant and animal cells placed in each of the three types of solutions
- explain how to make solutions by percentage weights

Materials:

- IBM computer lab using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Passive Transport: Diffusion and Osmosis
- worksheet associated with this lesson

Do Now:

What can be done to alter the water content of plant or animal cells?

Motivation:

If a person lost a large quantity of body fluid, why is a salt solution used, instead of pure water, for an intravenous injection?

Development:

1. Elicit from the class responses to the motivational question.

2. Write several of these answers on the board and then explore each one with the class.

3. If the class has difficulty with the correct answer, lead the class to understand that most cells exist in an aqueous environment, either internal or external. Guide the students to understand that if the concentration of water and salt that surrounds the cell is altered, osmosis will cause water to enter or exit the cell.

4. Review previous lesson objectives by asking students to indicate in which direction water molecules will travel when cells are placed in solutions of different concentrations.

5. Challenge the class to describe how the shapes of the plant and animal cells will change when placed in environments of different salt concentration. Establish that the cell wall of plant cells will limit the expansion of the cell. In plant cells, instead of the cell expanding, the cell's internal pressure will increase.

6. Introduce the terms hypertonic, isotonic, and hypotonic to the class. Define these terms briefly as they are well-defined in the computer program.

7. At this time explain to the students that with the aid of computers you are about to help them obtain a better understanding of how osmosis can affect the functioning and shape of plant and animal cells.

8. Remind the students of the basic procedures of computer operation. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up (load).

9. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a screen identifying the program. Instruct the students to press the #4 key on top of the keyboard to enter the section of the program: Osmosis and the Cell.

10. Allow the students a reasonable amount of time to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point.

11. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. What is meant by the term hypertonic?
2. What is meant by the term hypotonic?
3. What is meant by the term isotonic?
4. Explain how osmosis can change the size and shape of animal cells.
5. Compare the results of placing plant and animal cells in hypotonic solutions.

Homework:

1. Complete the worksheet associated with this lesson.

Enrichment:

1. Compare passive and active transport. Give an example of active transport in plants and animals.

2. What is Ringer's solution? Where is it most commonly used? How is it made?

3. Why do lettuce, and several other vegetables, become crisp when placed in water. What would happen if you put a piece of meat, such as ham, in the water?

4. What would happen to lettuce if you placed it in a highly-concentrated (hypertonic) salt water solution?

WORKSHEET — Transport in Plant and Animal Cells

Name ______________________ **Class** ________ **Date** __________

Part I - In the space provided below, draw a diagram illustrating what you would observe before and after you placed a plant cell in a hypertonic solution. Label your drawing. Title your drawing using correct scientific terminology.

Before After

Part II - Completion Questions

1. Living cells are surrounded by an ________________ environment.

2. The water inside the cell and the water in the environment are in a state of ____________ .

3. A ___% salt solution is considered isotonic.

4. Animal cells expand in a _____________ solution.

5. Plant and animal cells do not change their size or shape in ___________ solutions.

6. Plant and animal cells shrink in _______________ solutions.

7. The pressure inside of a plant cell increased when it is placed in a __________________ solution.

8. _____________ solutions can be used to make vegetables crisp.

9. Plant cells cannot expand like animal cells because plant cells have __________________ .

10. When placed in a hypotonic solution, plant cells cannot reach a state of _____________.

TOPIC 30
Aerobic Respiration

Aim: How does respiration provide energy for the cells of the body?

Performance Objectives: The students will be able to:

- state that aerobic or cellular respiration is the process which releases energy from food with the aid of oxygen
- state that the energy from food is provided to the cells in the form of glucose.
- explain how during the phase called anaerobic respiration, the glucose is oxidized (loses hydrogen) to form carbon dioxide and water and a small amount of energy
- describe how the energy produced during aerobic oxidation is used to produce ATP
- state that during vigorous exercise, cells do not receive a sufficient amount of oxygen, and an oxygen debt is created
- state that fermentation is the process whereby small amounts of energy are released without the presence of oxygen
- define the term HOMEOSTASIS
- describe how carbon dioxide and lactic acid cause an increase in the breathing rate
- state that lactic acid causes muscle fatigue
- explain the effect of hyperventilation on the oxygenation of the blood

Materials:

- IBM computer lab using color monitors
- software package: Arrakis Advantage - Biology - Volume I by Prentice Hall (An identical software package is also available for Apple computers but was not tested)
- worksheet associated with this lesson
- peanut and stand to support it

Do Now:

What is the role that the respiratory system plays in releasing the energy stored in food.

Motivation:

Tell the students that the energy they need for everyday activity is derived from the food that they eat. Burn a peanut to demonstrate how the oxidization of nutrients can release energy.

Development:

1. Explore the various answers that the students give to the motivational question. Explain that the respiratory system supplies the body with the oxygen that is needed to release the energy from glucose in the body cells. The oxygen will be used to oxidize the nutrients, and thus release the potential chemical energy stored in the food that we eat.

2. Explain that the potential energy found in food is released through a series of chemical reactions within the cells of the body.

3. Explain to the students that with the aid of computers you will teach them about the chemical reactions which are necessary to provide the energy we need for everyday activities.

4. Before beginning the computer segment of this lesson, hand out the worksheet associated with this lesson. Explain to the students that the chemical reactions shown on the worksheet are more involved than those demonstrated in the computer program. Ask the students to correlate the stages of the chemical reactions shown in the computer program with the more complex reactions given on the worksheet.

5. Remird the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software by telling the students not to bend the diskettes and not to put their fingers on the cut-out window of the disk.

6. Have the students turn on their monitors and then insert DISK I of the program into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up (load). The program will begin with a short piece of music. When the music stops instruct the students to type the words "GOTO AEROBIC RESPIRATION" and then press the ENTER key. This procedure will open the program in the proper section to study the appropriate material for this lesson.

7. Allow the students a reasonable amount of time to operate and explore the program. It introduces the basic principles of aerobic respiration and oxygen debt. It also defines the term FERMENTATION as associated with the release of energy. The role that lactic acid plays in muscle fatigue is also illustrated as is the concept of hyperventilation. Following the instructional activity, the software will provide the students with an opportunity to answer questions and will provide correct answers in the event that the student fails to give the proper answer. The students should proceed no further then the section concerned with oxygen debt. The program goes on to material not covered in the lesson.

8. In the event that the student has difficulty with the computer program, there are several options open to the student. If a student had difficulty understanding the concepts presented in the last few screens, the student may type the word REPEAT and then press the enter key. The last few screens will be repeated. If a student has forgotten a word or concept presented earlier in the program, the student can type DEFINE followed by the word or concept, and the press the enter key. EX. DEFINE LUNGS. The word or concept will be explained again.

9. At the completion of the computer-guided instructional activity have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Explain the aerobic phase of cellular respiration.
2. Explain the relationship between the respiratory system and the food we eat.
3. Why must food be digested before it can supply us with energy?
4. What is the role of ATP in respiration?
5. Describe the conditions that lead to the creation of an oxygen debt.
6. Define fermentation in terms of the process occurring in the release of energy for body use.
7. Define homeostasis.
8. Name 2 chemicals that can alter the breathing rate.
9. Define hyperventilation. Describe its role in the release of energy.

Homework:

1. Complete the worksheet that was given out at the beginning of the class.

Enrichment:

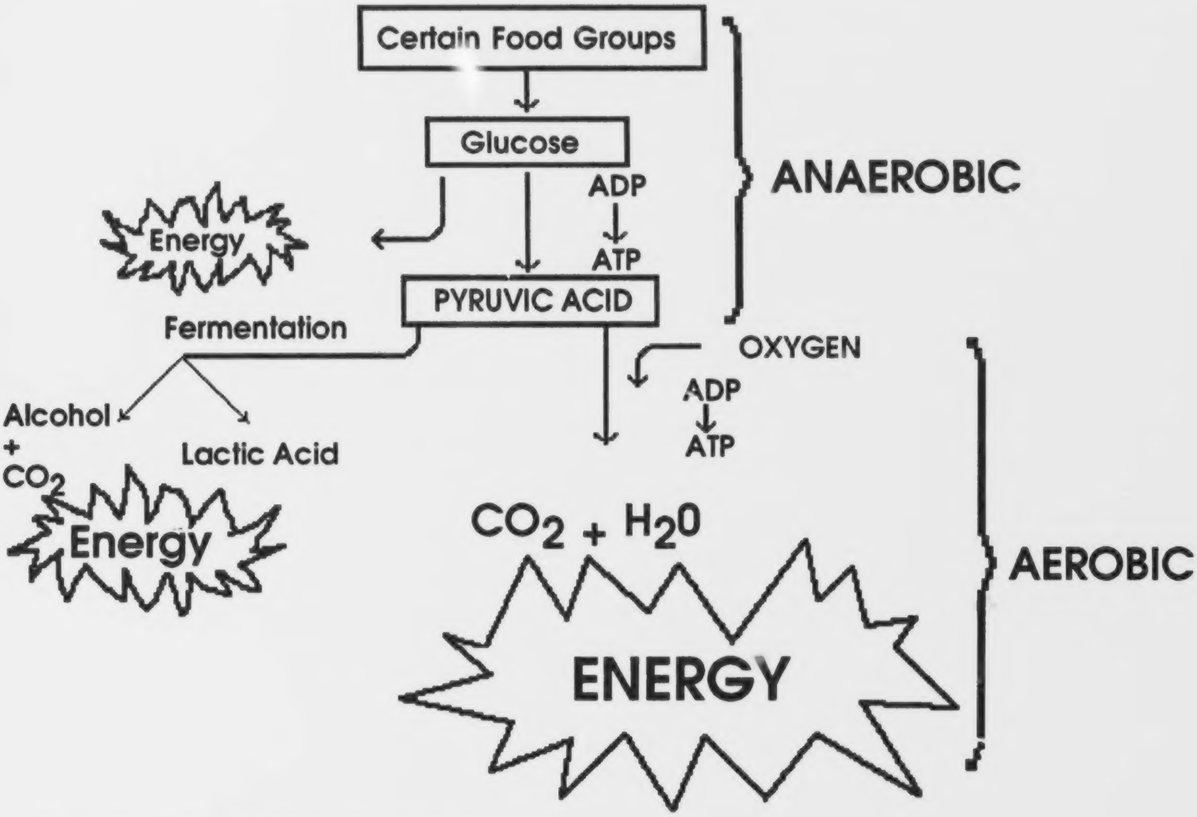
1. Hyperventilation is sometimes used by divers to increase the length of time that they can stay under water. Explain how hyperventilation can increase the length of time for which you can hold your breath. Caution: Explain why this process may be dangerous.

2. Some bacteria are known as anaerobic bacteria. What is special about these organisms?. Name a disease caused by anaerobic bacteria.

WORKSHEET — Aerobic Respiration

Name ______________________ Class ________ Date __________

Part I: As you progress through the computer program, compare the chemical reactions illustrated in the program with those given below. See if you can correlate the two different sets of chemicals.


Certain Food Groups
Glucose
ADP
ATP
Energy
PYRUVIC ACID
ANAEROBIC
Fermentation
Alcohol + CO_2
Lactic Acid
Energy
OXYGEN
ADP
ATP
$CO_2 + H_20$
ENERGY
AEROBIC

Part II - Completion Questions

1. Oxidation is a loss of ________________.

2. During aerobic respiration, the cells need ____________ to release energy.

3. Energy cannot be directly obtained from food. The food must first be ________________.

4. The form of cellular respiration which releases the greatest amount of energy is ______________________.

5. Two substances which increase the rate of breathing are ______________________ and ________________

6. The substances which is most responsible for muscle fatigue is ________________________.

TOPIC 31
Respiration

Aim: What is respiration?

Performance Objectives: The students will be able to:

- state that living things need energy to continue living
- state that respiration consists of the processes needed to release energy
- understand that most organisms (aerobes) use oxygen to release energy
- explain how gills perform as the organ of respiration in fish
- understand that humans use some nutrients from food as fuel, and that oxygen is used to release the energy of the food
- understand that human respiration requires mechanical movement and chemical change
- identify breathing, gas exchange and cellular respiration as the three stages of human respiration

Materials:

- IBM computer lab using color monitors
- software package: Arrakis Advantage - Biology - Volume I by Prentice Hall (an identical software package is also available for Apple computers but was not tested)
- model, chart or diagram of the gill structure of fish
- model, chart or diagram of the human respiratory system

Do Now:

List five ways in which the body uses energy.

Motivation:

Ask several students for their definition of the word breathing. Write several of their responses on the board. After briefly exploring each response, ask the class if all living organisms breathe.

Development:

1. Explore the student's responses to this question: "Do all living organisms breathe?"

2. Show the students the model or chart of the gill structure of a fish. Ask those students who may have had past experiences observing fish if they can see any similarity between human breathing and the gill movement of a fish.

3. Tell the class that while respiration is a function performed by fish, breathing is not part of the process. Fish do not breathe, but they do carry on the life function of respiration.

4. At this time explain to the students that with the aid of computers you are about to introduce them to the concept of respiration, a process that is often confused with breathing.

5. Introduce the students to the special operational keys needed to successfully run this program. The four cursor control keys (the arrow keys found on numbers 2, 4, 6, and 8 on the numeric keypad) are used to control the movement of objects on the screen. These objects are items such as tweezers, magnifying glasses and microscopes. When the program requests that a student either pick up something or operate something, the student must hold down the control key and then simultaneously press the A key. An example would be if the program asked a student to examine the gills of a fish with a microscope. The student would use the cursor keys to maneuver the microscope to the gill area of the fish appearing on the screen. After doing this, the student would then hold down the control key and then press the 'A' key to see an enlarged view of the gill area.

6. Have the students turn on their monitors and then insert DISK I of the program into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up(load). This software package is self loading.

7. The program commences with a picture of the heart and lungs. A short tune is played as two screens quickly introduce the name of the software and the publisher. When the music stops instruct the students to type the words "GOTO RESPIRATORY SYSTEM" and then press the ENTER key.

8. Allow the students 10-15 minutes to operate and explore the program. It explains the relationship between human breathing and respiration. The program also clearly illustrates the connection between respiration and nutrition from food. It allows the student to duplicate on the screen some experiments that would normally be done in the laboratory. One such experiment is the exhalation through limewater to show the presence of carbon dioxide. Another experiment provides the student with two fairly good microscopic views of the gill structure. Following the instructional activity, the software will provide the students with an opportunity to answer questions and will provide correct answers in the event that the student fails to give the proper answer. The students should proceed no further than the section concerned with the phases of respiration. After this section, the software goes on to discuss material not covered in this lesson.

Summary:

1. Do all living organisms breathe? Explain?
2. How does respiration differ from breathing?
3. What is the relationship between food intake, respiration and the release of energy?
4. Which element do most organisms need to acquire through the process of respiration?
5. What are the two waste products of human respiration?
6. What are the three phases of human respiration?
7. What indicator can be used to test for the presence of carbon dioxide?

Homework:

1. Describe the structure of gills as observed through a microscope. Draw a picture illustrating the structure of gills.
2. Why is respiration known as a LIFE FUNCTION?
3. What is the relationship between food intake and respiration?
4. Describe an experiment to show that carbon dioxide is a waste product of respiration.
5. Describe a simple procedure to show that water is a waste product of respiration.

Enrichment:

1. Do plants perform the process of respiration? If they do, how does it differ from the way in which animals perform the function of respiration?
2. Can you name any animals besides fish that do not breathe?
3. What are anaerobic organisms? How do they obtain energy?
4. Before the days of modern medicine, people would often hold a mirror or another polished object under the nose of a person to see if that person was alive, or in a coma, or perhaps dead. What was the reason for this seemingly strange behavior?

TOPIC 32
What is Respiration?

Aim: What is the structure and function of the human respiratory system?

Performance Objectives: The students will be able to:

- describe the processes of respiration and breathing
- name and identify the structures of the human respiratory system
- explain how cellular respiration differs from breathing
- distinguish between internal respiration and external respiration and identify the structures associated with each process
- describe the processes responsible for inhalation and exhalation
- explain what factors control the rate of breathing in humans

Materials:

- MS-DOS computer labs, DOS
- Software: Human Life Processes II: Systems Level, IBM software
- Bell jar model of the human chest cavity
- worksheet containing an unlabeled diagram of the human respiratory system

Do Now:

Use your textbook glossary to define each of these terms: external respiration, internal respiration, breathing, respiratory membrane

Motivation:

1. Display the bell jar model of the human respiratory system and demonstrate how it works. After demonstrating this model the teacher should ask: Why do the lungs inflate if they are suspended in the middle of the jar and are not attached to the rubber diaphragm at the bottom of the model?

2. Elicit student responses and list them on the chalkboard. Introduce the computer software and explain to the students that they use the computers to learn the structures and functions of the human respiratory system.

Development:

1. Distribute the software and the DOS disks. If the students are not familiar with the operation of the computers inform them that they should not bend or fold the disks and should not place anything but the diskettes into the disk drive.

2. Instruct the students to insert the DOS disk into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. When they get the date/time prompts tell them to strike the space bar. When they get the "A" prompt, instruct them to remove the diskettes and insert the program disk. They should type the word "autoexec" and press the enter key.
   WARNING: The teacher should follow the instructions contained within the software documentation prior to the first operation of the program. A backup disc must be prepared. Instructions are also provided for the preparation of self-loading program disks. This would eliminate the need

for the DOS when the students load the programs on IBM computers.

3. After the program has loaded, the students are presented with a menu screen. Instruct the students to select section 2, RESPIRATORY SYSTEM. Allow the students sufficient time to complete this activity. This program requires a minimum of 30 minutes of classroom time. The program provides the students with the information and tasks listed below. It also introduces the vocabulary of respiration and provides the students with the opportunity to consult the self-contained glossary during the evaluation segments. The program outlines:
    a. a diagram of the human respiratory system
    b. a definition of the process of cellular respiration, which is enhanced with animation of the process within the cell.
    c. Definitions and animation which teach internal and external respiration.
    d. Exploration: the parts of the human respiratory system. The students can select each of the labeled structures and learn more about it.
    e. Quiz - at the conclusion of the quiz, the students are given a review if they achieved a score of less than 70%
    f. The location and function of the alveolus.
    g. Rib cage movement and its relationship to the process of breathing.
    h. Diaphragm movement.
    i. A table of the composition of air.
    j. Experiment: The change in breathing rate - the students are given the opportunity to vary the carbon dioxide and oxygen levels in the atmosphere and observe how changes in the composition of air affect the breathing rate.
    k. Medullary control of respiration - the graphic representation shows how changes in the levels of carbon dioxide in the blood affect the medulla and the connection between the medulla and the control of breathing.
    l. Information: Respiration - a review, followed by a six-question matching quiz.

4. This program contains provisions for printing a copy of the information which is displayed on the screen. This requires the use of a graphics printer. The instructions for this procedure are contained in the software documentation.

5. At the conclusion of the computer activity, instruct the students to place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers and monitors.

Conclusion:

1. Distribute the worksheet and instruct the students to label the parts of the human respiratory system and to answer the questions.

2. Review the student responses.

Homework: Use your biology textbook to help you complete this assignment.

1. Read the chapter on respiration and breathing in humans and answer these questions:
    a. Why do people who climb mountains or work at high altitudes have difficulty breathing?
    b. How would the human respiratory system respond if a person was trapped in a sealed room and the air was being depleted? Why?
    c. How does respiration differ from breathing?

Enrichment:

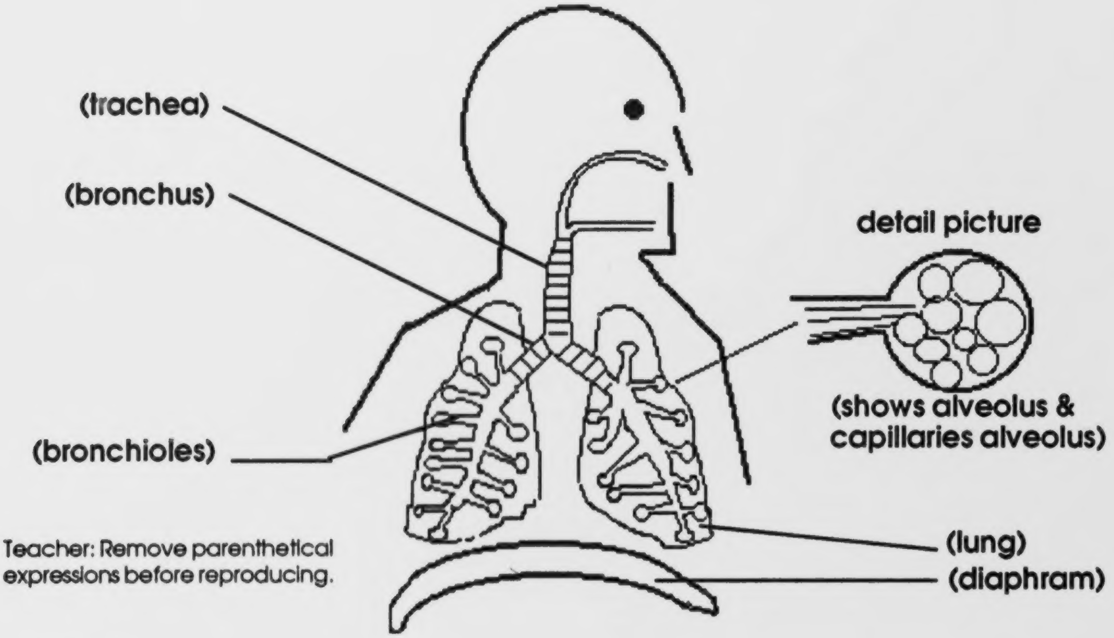
Investigate several disorders or malfunctions which may affect the human respiratory system. Discuss the causes, the damage that occurs to the person's respiratory system and the treatments that are used to cure or alleviate the conditions.

WORKSHEET — What is Respiration?

Name ________________________ Class ________ Date __________

Part I

Directions: label each of the structures of the human respiratory system


(trachea)
(bronchus)
detail picture
(shows alveolus & capillaries alveolus)
(bronchioles)
(lung)
(diaphram)

Teacher: Remove parenthetical expressions before reproducing.

Part II

1. What determines the respiratory rate in a normal healthy human being?
2. What is meant by external respiration?
3. What is the process of internal respiration?
4. What is cellular respiration?
5. How does breathing differ from respiration?
6. Why is the involuntary control of respiration an example of homeostasis?

TOPIC 33
The Nose

Aim: How does the nose function in the respiratory system?.

Performance Objectives: The students will be able to:

- state that the nose is the beginning of the respiratory tract
- understand that the nostrils are scientifically referred to as nares
- describe how the nasal chambers lie inside the nose and behind and above the nares
- explain that the nasal septum is composed of cartilage
- explain how the air we breath is conditioned by the mucus membrane lining the nasal cavity.
- describe how a foreign particle that enters the nose can initiate an allergic response such as sneezing
- illustrate how the cilia of the nasal tract function to clean the air entering the respiratory system
- locate and identify the function of the olfactory glands

Materials:

- IBM computer lab. using color monitors
- software package: Arrakis Advantage - Biology - Volume I by Prentice Hall (an identical software package is also available for Apple computers but was not tested)
- model, chart or diagram of the nose

Do Now:

Describe the noses of several different animals, preferably mammals.

Motivation:

Inform the students that the nose is the first organ of the human respiratory tract. The nostrils serve to provide a passage for air to enter the respiratory system. Tell the students that the structure of the human nose is very distinct. No other species has a nose identical to the human nose.

Development:

1. On the board write several of the student responses to the motivational question.

2. Explore several of these answers with the class and then ask the students if they can deduce any biological significance for the various shapes of noses. Again, take time and discuss several of the responses with the students.

3. Challenge the students to describe an elephant's trunk (nose). How does an elephant use its trunk? Can they explain the different ways in which the elephant uses its trunk? How many of these functions are related to respiration? Guide the students to understand that the trunk is used for tactile, manipulation and olfactory purposes, as well as other functions.

4. Challenge the class to describe the nose of a whale or dolphin. Explain to the students that these animals do not posses a type of nose that is very pronounced. The noses of these animals consists of one or two blowholes or vents through which air passes. Can the students explain why this type of nose functions well for dolphins and whales?

5. At this point, show the students the model or chart of the human nose. Indicate to the class the complex internal structures of the nose. Explain to the class that the human nose has many parts and performs several functions.

6. At this time explain to the students that with the aid of computers you are about to introduce them to the structure and functions of the human nose.

7. Remind the students of the basic procedures of computer operation and reinforce proper handling procedures for disk-based software.

8. Have the students turn on their monitors and then insert DISK I of the program into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up (load). This software package is self-loading.

9. The program commences with a picture of the heart and lungs. A short tune is played as two screens quickly introduce the name of the software. When the music stops instruct the students to type the words "GOTO NOSE" and then press the ENTER key.

10. Allow the students a reasonable amount of time to operate and explore the program. It explains the structure and functions of several areas of the nose. It illustrates how the mucus linings of the nasal chambers moisten and warm the air as it enters the respiratory tract. There is an excellent animated illustration of how the cilia remove foreign particles from the nasal passages. There is also a humorous illustration depicting the sneezing response. Following the instructional activity, the software will provide the students with an opportunity to answer questions and will provide correct answers in the event that the student fails to give the proper answer. The students should proceed no further than the section concerned with the nose. After this section, the software goes on to discuss material not covered in this lesson. The next lesson is about other organs of the respiratory system.

11. In the event that the student has difficulty with the computer program, there are several options open to the student. If a student had difficulty understanding the concepts presented in the last few screens, the student may type the word REPEAT and then press the enter key. The last few screens will be repeated. If a student has forgotten a word or concept presented earlier in the program, the student can type DEFINE followed by the word or concept, and then press the enter key, e.g., DEFINE NARES or DEFINE CILIA. The word or concept will be explained again.

12. At the completion of the computer guided instructional activity have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. What is the first organ of the respiratory system?
2. What is the scientific name for the nostrils?
3. What are the nasal septums composed of?
4. How does the mucus lining of the nasal passages condition the air we breathe?
5. What is the function of the coarse hairs located at the entrance to the nares?
6. What is the function of the olfactory organ?
7. How do the cilia located in the nasal passages contribute to our health and well being?

Homework:

1. What is the name of the structure that divides the nasal passages?
2. What is the function of the coarse hairs that are located at the beginning of the nares?
3. Describe two ways in which the air is changed as it passes through the nasal chambers?
4. Draw a picture showing how the nasal cilia help to clean the nasal passages of dust particles.
5. Give a brief description of why humans sneeze.
6. Where are the olfactory glands located? What is their function?

Enrichment:

1. Make a diagram of the nose clearly showing its internal structure. Label as many important parts as you can.
2. Many individuals suffer from a condition commonly known as a deviated septum. What is this condition? How can this condition be corrected?
3. What are the functions of the nasal sinuses? How can they affect your voice?
4. What happens to your nose when you have a cold? Explain why this change occurs. Is this a beneficial change?
5. Research and report on the possible hazards of excessive use of nasal sprays.

TOPIC 34
The Lower Respiratory System

Aim: What are the organs of the lower respiratory system and how do they function?

Performance Objectives: The students will be able to:

- state that the pharynx is a muscular cavity located at the back of the mouth.
- understand that the voice box is scientifically referred to as the larynx.
- state that the glottis is the opening of the larynx
- describe the appearance and function of the vocal cords.
- describe the purpose and appearance of the epiglottis
- explain how the epiglottis prevents food from entering the trachea
- state that the esophagus is located behind the trachea
- state that the trachea begins in the larynx and extends to the lungs where it forms two bronchi
- describe how rings of cartilage support the trachea
- state that the lungs are the largest organs in the chest cavity
- describe the spatial relation between the heart and lungs
- describe the location of the diaphragm below the lungs
- state that the parietal membrane and the visceral membrane are the two membranes associated with the lungs

Materials:

- IBM computer lab using color monitors
- software package: Arrakis Advantage - Biology - Volume I by Prentice Hall (an identical software package is also available for Apple computers but was not tested)
- model of the human respiratory system or a model of the human torso
- worksheet associated with this lesson

Do Now:

Trace the path of the air we inhale as it passes through the nose into the body.

Motivation:

Display the torso model or diagram of the respiratory system and ask the students to identify the structure used for breathing.

Development:

1. Give each student in the class a copy of the worksheet associated with this lesson. Let them examine the diagram of the organs of the respiratory system. Tell them the labels identifying the various organs have been left blank, and that it will be one of their assignments in this lesson to identify the organs as they proceed with the lesson.

2. Use the large model of the respiratory system (or the model of the human torso). Ask the students if they know the names of any of these organs. Many students will be able to identify the lungs. Introduce the other structures.

3. At this time explain to the students that with the aid of computers you are about to introduce them to the organs of the respiratory system. Explain that the program will teach them the names and functions of many organs associated with the respiratory system.

4. Remind the students of the basic procedures of computer operation.

5. The program commences with a picture of the heart and lungs. A short tune is played as two screens quickly introduce the name of the software and the publisher. When the music stops instruct the students to type the words "GOTO PHARYNX " and then press the ENTER key. This procedure will open the program in the proper section to study the appropriate material for this lesson.

6. Allow the students a reasonable amount of time to operate and explore the program. The computer program is of a tutorial nature and is highlighted by many excellent animated illustrations. It explains the structure and functions of several organs of the respiratory system. The program is broken into sections covering the pharynx, larynx, trachea and lungs. There are many excellent illustrations in this program, several of them being animated. The movement of the vocal cords is illustrated very clearly. The cartilaginous rings supporting the trachea are also nicely illustrated. Following the instructional activity, the software will provide the students with an opportunity to answer questions and will provide correct answers in the event that the student fails to give the proper answer. The students should proceed no further than the section concerned with the lungs. After this section, the software goes on to discuss material not covered in this lesson.

7. In the event that the student has difficulty with the computer program, there are several options open to the student. If a student had difficulty understanding the concepts presented in the last few screens, the student may type the word REPEAT and then press the enter key. The last few screens will be repeated. If a student has forgotten a word or concept presented earlier in the program, the student can type DEFINE followed by the word or concept, and the press the enter key, e.g., DEFINE LUNGS. The word or concept will be explained again.

8. At the completion of the computer-guided instructional activity have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Which organ of the respiratory system can be described as a muscular cavity?
2. What is the scientific name for the voice box?
3. What is the name of the opening through the larynx?
4. Describe how the epiglottis prevents food from going down the trachea.
5. Describe the appearance of the vocal cords.
6. Where is the trachea located?
7. What is the shape of the sections of cartilage which helps to support the trachea?
8. Name the membranes associated with the lungs.
9. Where is the diaphragm located?

Homework:

1. Complete the worksheet that was given out at the beginning of the class.

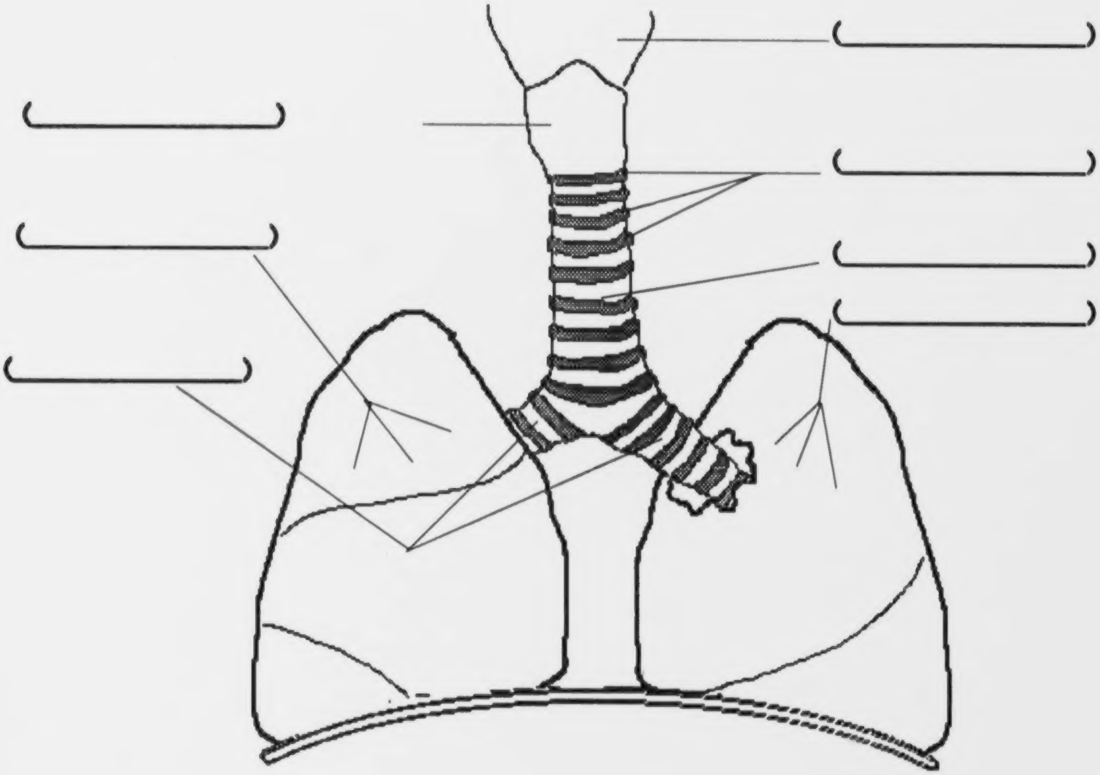
Enrichment:

1. See if you can make a life-size diagram of all the organs that were covered in this lesson. Label the diagram. How large do you think your larynx is? What is the length of your trachea? How far into your chest cavity do your lungs extend?
2. The pharynx is really just the scientific name for the throat. Can you find the scientific name for a "sore throat"?
3. A tracheotomy can be a simple life-saving emergency operation. What is this procedure and why is it performed?
4. Most students can easily find their Adam's Apple. What is the scientific name for the Adam's Apple? Gently touch your Adam's Apple as you say a few words. What do you feel? What do you think is causing this vibration?
5. Explain the role of the larynx in the production of sound.
6. Research and report on common unhealthful practices that may cause serious damage to the respiratory organs.

WORKSHEET — The Lower Respiratory System

Name __________________________ Class ________ Date __________

Part I: As you progress through the computer program, fill in the names of the parts of the respiratory system.



Part II - Completion Questions

1. The _____________ is located on top of the trachea.

2. The opening of the larynx is called the _______________.

3. Rings of _______________ prevent the trachea from collapsing and shutting off the supply of air to the lungs.

4. The scientific name for the throat is ________________.

5. The trachea branches to form two tubes which are known as the _______________.

6. The __________ lung is the larger of the two lungs and is divided into _______ lobes (sections).

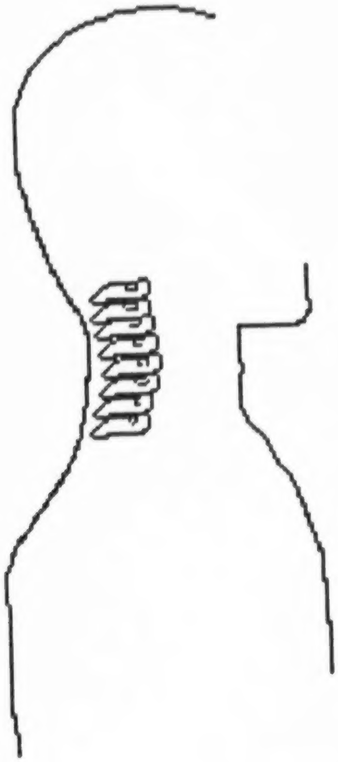
7. The lungs are each covered by a membrane known as the _____________ membrane.

8. The membranes of the lungs are separated from each other by _________.

9. The parts of the respiratory system which are responsible for speech are the __________________________.

10. The ____________________ prevents food from entering the trachea.

Part III: On the diagram below, draw in the larynx, trachea, esophagus, and part of the lungs. Take care in indicating whether the trachea or the esophagus lies in the front of the neck.



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TOPIC 35
Inhalation and Exhalation

Aim: What are the body mechanics involved in inhalation and exhalation?

Performance Objectives: The students will be able to:

- describe how the external intercostal muscles contract to move the rib cage outward to help with inhalation
- explain how the diaphragm contracts and causes the lungs to expand downwards
- describe how the internal intercostal muscles contract to move the rib cage inward to help with exhalation
- explain how the diaphragm pushes upward to decrease the size of the chest cavity and thus help exhalation
- state that inhalation is a mechanical process that increases the size of the chest cavity (thoracic cavity)
- explain how the increase in the size of the thoracic cavity causes the lungs to fill with air because of a reduction in air pressure
- explain how the decrease in the size of the thoracic cavity causes the lungs to expel air because of an increase in the air pressure
- ** optional - demonstrate how the Heimlich Maneuver can be used to help a person who is choking
- ** optional - explain how the Heimlich Maneuver mimics the mechanics of exhalation and thereby expel food trapped in the trachea

Materials:

- IBM computer lab. using color monitors
- software package: Arrakis Advantage - Biology - Volume I by Prentice Hall (an identical software package is also available for Apple computers but was not tested)
- bell jar apparatus
- human torso model

Do Now:

Define each of these terms: exhalation, inhalation, thoracic cavity, diaphragm.

Motivation:

Show the students the bell jar apparatus. Without any explanation, demonstrate the apparatus to the class. Challenge the students to explain why the balloons expanded and contracted within the bell jar.

Development:

1. Explore the various answers that the students give to the motivational question. Explain to the class that the movement of the balloons within the bell jar is very similar to the movement of the lungs within the thoracic cavity.

2. Ask the students to think of the bell jar apparatus as a model of the human thoracic cavity. The glass bell jar representing the rib cage, the rubber sheet representing the diaphragm, and the balloons representing

the two lungs.

3. Show the model of the human torso to the class. Point out the rib cage, diaphragm and lungs to the class. Ask the students to visualize how these organs of the human respiratory system act like the bell jar apparatus to bring air into and out of the lungs.

4. Point out to the class that the rubber sheet is very much like the structure of the human diaphragm. Tell the students that the glass of the bell jar is not a good representation of the human rib cage. Ask the students to give an explanation for this statement.

5. At this time explain to the students that with the aid of computers you are about to teach them how the body inhales and exhales air. (If the teacher would like to have the students learn about the Heimlich Maneuver there is an additional lesson of about four minutes duration explaining this simple-life saving procedure. This lesson is presented directly after the tutorial on the mechanics of inhalation and exhalation.)

6. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software. Have the students turn on their monitors and then insert DISK I of the program into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up (load). This software package is self-loading.

7. The program commences with a picture of the heart and lungs. A short tune is played as two screens quickly introduce the name of the software and the publisher. When the music stops instruct the students to type the words "MECHANICS OF BREATHING" and then press the ENTER key. This procedure will open the program in the proper section to study the appropriate material for this lesson. Allow the students a reasonable amount of time to operate and explore the program. It explains the mechanics of breathing using many excellent animated illustrations. The movement of the rib cage and diaphragm is very clearly shown. It also explains the roll that air pressure plays in filling and emptying the lungs. The bell jar demonstration is also nicely recreated on the computer screen. Following the instructional activity, the software will provide the students with an opportunity to answer questions and will provide correct answers in the event that the student fails to give the proper answer. The students should proceed no further then the section concerned with the mechanics of breathing or alternatively the Heimlich Maneuver. The next section of this computer program goes on to cover new material not discussed in this lesson.

9. In the event that the student has difficulty with the computer program, there are several options open to the student. If a student had difficulty understanding the concepts presented in the last few screens, the student may type the word REPEAT and then press the enter key. The last few screens will be repeated. If a student has forgotten a word or concept presented earlier in the program, the student can type DEFINE followed by the word or concept, and the press the enter key, e.g., DEFINE LUNGS. The word or concept will be explained again.

10. At the completion of the computer-guided instructional activity have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Describe how the internal intercostal muscles help in the process of inhalation.
2. Describe the role of the diaphragm in inhalation.
3. Describe how the external intercostal muscles help in the process of exhalation.
4. Describe the role of the diaphragm in exhalation.
5. Describe how the thoracic cavity changes during inhalation and exhalation.
6. Explain the role that differential air pressure plays in filling the lungs with air.
7. Describe the process whereby air is expelled from the lungs.
8. ** optional - Demonstrate the Heimlich Maneuver. Explain the theory behind this procedure.

Homework:

1. What is the name of the muscles that expand the rib cage to allow air to enter the lungs?
2. In what direction does the diaphragm move to allow air to enter the lungs?
3. Define inhalation.
4. Define exhalation.
5. What is the name of the muscles responsible for lowering the rib cage to aid in the process of exhalation?
6. Describe the movement of the diaphragm during exhalation.
7. Explain the forces responsible for the movement of the balloons within the bell jar apparatus.
8. In what way is the bell jar apparatus comparable to the human respiratory system.

Enrichment:

1. Are the lungs of most of the students in your class approximately the same size? Can you think of a method for measuring the amount of air that your lungs can hold?

2. Research the term "IRON LUNG." What is an iron lung, and when is it used? Are iron lungs currently in common use in your community's hospitals?

3. What is a respirator? What diseases make the use of respirators mandatory?

TOPIC 36
Capacity of the Lungs

Aim: What is the capacity of the lungs?

Performance Objectives: The students will be able to:

- state that the total volume of the lungs is approximately six liters
- state that the TIDAL VOLUME is the amount of air that is normally inhaled and exhaled
- state the the tidal volume is approximately 500 cubic centimeters
- define the term expiratory reserve volume
- define the term inspiratory reserve volume
- define the term vital lung capacity
- state that the supplemental air is equal to the tidal volume plus the expiratory reserve volume
- state that the complemental air is equal to the tidal volume plus the inspiratory reserve volume
- explain that when you become more active, the respiratory system attempts to maintain the supply of oxygen to the body
- describe how an instrument called a spirometer measures lung capacity (the software refers to a spirometer as a vitalometer
- state that the minimal air is the air that remains in the lungs after the deepest exhalation

Materials:

- IBM computer lab. using color monitors
- software package: Arrakis Advantage - Biology - Volume I by Prentice Hall (an identical software package is also available for Apple computers but was not tested)
- a quantity of large round balloons

Do Now:

How does a doctor test a person's lung capacity? Why is this an important part of a physical exam?

Motivation:

Challenge the class to find a method of measuring the volume of air held by the lungs. As you finish asking the questions place a number of balloons on you desk or lab table.

Development:

1. Explore the various answers that the students give to the motivational question. Some students will probably have suggested blowing into the balloons as a method to measure the volume of air. Have some students come to the front of the room and blow up balloons.

2. After they finish, point out to the class that although the balloons were indeed filled with air from within the lungs, scientists use other, more accurate means to measure the lung volume. Point out to the class that most students took a deep breathe before attempting to blow up the

balloon. Point out that the students also expelled as deeply as possible into the balloon. Explain to the class that the volume of air in most of the balloons does not represent the amount of air that the students normally inhale and exhale. Tell the students that scientists have a number of terms to describe the air which we breathe.

3. At this time explain to the students that with the aid of computers you are about to teach them about the terminology and methods scientists use to explore the lung capacity.

4. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software by telling the students not to bend the diskettes and not to put their fingers on the cut-out window of the disk.

5. Have the students turn on their monitors and then insert DISK I of the program into the disk drive (drive A if it is a two drive system). The students must then turn on the computer's power and wait for the software to boot up (load). This software package is self-loading.

6. The program commences with a picture of the heart and lungs. A short tune is played as two screens quickly introduce the name of the software and the publisher. When the music stops instruct the students to type the words "GOTO LUNG CAPACITY" and then press the ENTER key. This procedure will open the program in the proper section to study the appropriate material for this lesson.

7. Allow the students a reasonable amount of time to operate and explore the program. The computer program is of a tutorial nature and is highlighted by many excellent animated illustrations. It explains the basic terminology associated with various capacities of the lungs. It nicely illustrates the vitalometer (spirometer), an instrument used to measure lung capacity. It shows how this instrument produces a sine wave graph to represent the different capacities of the lungs. Following the instructional activity, the software will provide the students with an opportunity to answer questions and will provide correct answers in the event that the student fails to give the proper answer. The students should proceed no further then the section concerned with lung capacity. The program goes on to discuss the role of the medulla, and the effect it has upon the breathing, material not covered in the lesson.

8. In the event that the student has difficulty with the computer program, there are several options open to the student. If a student had difficulty understanding the concepts presented in the last few screens, the student may type the word REPEAT and then press the enter key. The last few screens will be repeated. If a student has forgotten a word or concept presented earlier in the program, the student can type DEFINE followed by the word or concept, and the press the enter key, e.g., DEFINE LUNGS. The word or concept will be explained again.

9. At the completion of the computer-guided instructional activity have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Have the students define each of the following terms:
    a) tidal volume
    b) expiratory reserve volume
    c) inspiratory reserve volume
    d) vital lung capacity
    e) supplemental air
    f) complemental air
    g) minimal air
2. What is the normal amount of the tidal volume?
3. What happens when the body's need for oxygen increases?
4. What is a spirometer?
5. Describe some sample data from a spirometer.

Homework:

1. Give a definition for each of the following terms.
    a) tidal volume
    b) expiratory reserve volume
    c) inspiratory reserve volume
    d) vital lung capacity
    e) supplemental air
    f) complemental air
    g) minimal air

Enrichment:

1. Describe the structure of the lungs. What word best describes the interior of the lung?

2. What is meant by a collapsed lung? How does the size of a collapsed human lung compare to the normal size of the lung? Under what conditions would a human lung collapse?

3. Can you find a comparison of the lung sizes of various animals? Which animals has the largest lungs? Which animal has the smallest lungs?

TOPIC 37
Mechanisms for Gas Exchange

Aim: How are gases exchanged in the lungs?

Performance Objectives: The students will be able to:

- state that the bronchi divide many times to form the bronchioles
- understand that the bronchioles end in air sacs
- explain how each air sac is surrounded by the alveolar capillaries
- describe how each air sac is made up of a cluster of alveoli
- describe how oxygen diffuses through the alveoli into the blood
- explain how carbon dioxide passes from the blood to the alveoli
- compare inhaled and exhaled air and explain how their composition differs
- explain how diffusion is responsible for the exchange of gases within the lung
- state that water vapor is also diffused from the capillaries into the air sacs
- state that oxygen combines with hemoglobin in the blood to become oxyhemoglobin
- describe why oxygen turns the blood bright red
- state that oxygenated blood is pumped to all parts of the body by the heart

Materials:

- IBM computer lab. using color monitors
- software package: Arrakis Advantage - Biology - Volume I by Prentice Hall (an identical software package is also available for Apple computers but was not tested)
- model of the the human torso
- worksheet associated with this lesson

Do Now:

Why must you breathe faster when you exercise?

Motivation:

From previous lessons the students should know that oxygen is required for respiration while carbon dioxide and water vapor are expelled as waste products. Challenge the students to explain how the oxygen actually enters the body to be used by the various cells. Do the lungs actually force the oxygen into the body? Do the lungs forcibly pull the respiratory waste products from the the body?

Development:

1. Explore the various answers that the students give to the motivational question. Explain that to successfully answer the questions, they must have a better understanding of the interior structure of the lungs. At this point, give each student in the class a copy of the worksheet associated with this lesson. Let them examine the diagram of the air sacs and alveoli.

2. Remove the lungs from the model of the human torso and demonstrate them.

Explain to the students that there are approximately 14 million air sacs in the lung. Tell the students that the air sacs greatly increase the surface area of the lungs and that this is an important factor in the concept of diffusion.

3. Explain to the students that with the aid of computers you are about to teach them the role that diffusion plays in respiration. Explain to the students that the program will teach them how the gases associated with respiration are exchanged within the lungs. They will also learn how the oxygen reaches the cells of the body where it is needed for respiration.

4. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk based software. Introduce the students to the special operational keys needed to successfully run this program. The four cursor control keys (the arrow keys found on numbers 2, 4, 6, and 8 on the numeric keypad) are used to control the movement of objects on the screen. When the program requests that a student either pick up something or operate something, the student must hold down the control key and then simultaneously press the A key unless the program gives alternate instructions.

5. Instruct the students to turn on their monitors and then insert DISK I of the program into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to load. This software package is self-loading.

6. The program commences with a picture of the heart and lungs. A short tune is played as two screens quickly introduce the name of the software and the publisher. When the music stops instruct the students to type the words "GOTO AIR SACS" and then press the ENTER key. This procedure will open the program in the proper section to study the appropriate material for this lesson.

7. Allow the students a reasonable amount of time to operate and explore the program. It explains the structure and functions of several organs of the respiratory system. The program is broken into sections covering the bronchioles, air sacs, alveoli, and the exchange of gases. There are many excellent illustrations in this program, several of them being animated. The formation of oxyhemoglobin is nicely illustrated as is the movement of gases from the alveoli capillaries into the air sacs. Following the instructional activity, the software will provide the students with an opportunity to answer questions and will provide correct answers in the event that the student fails to give the proper answer. The students should proceed no further then the section concerned with air sacs and the exchange of gases. This is the last section on disk #1. Disk #2 contains more advanced information on the respiratory system.

8. In the event that the student has difficulty with the computer program, there are several options open to the student. If a student had difficulty understanding the concepts presented in the last few screens, the student may type the word REPEAT and then press the enter key. The last few screens will be repeated. If a student has forgotten a word or concept presented earlier in the program, the student can type DEFINE followed by the word or concept, and the press the enter key, e.g., DEFINE LUNGS. The word or concept will be explained again.

9. At the completion of the computer-guided instructional activity have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. What happens to the structure of the bronchi within the lungs?
2. Where are the air sacs located?
3. Where are the alveolar capillaries located?
4. Describe the structure of one air sac.
5. Describe the exchange of gases that occurs in the alveoli.
6. How does the composition of the air we inhale compare with the air we exhale?
7. Define diffusion.
8. What chemical changes occur in hemoglobin during respiration?
9. How does oxygenated blood reach the cells of the body?

Homework:

1. Complete the worksheet that was given out at the beginning of the class.

Enrichment:

1. When most people are exposed to extremely cold temperatures for long periods of times, their finger tips and lips often turn blue. Can you suggest an explanation for this change in coloration?

2. Many people have suffered at some point in their life from a disease called bronchitis. What is bronchitis? Which organ of the respiratory system does it affect? What causes this disease?

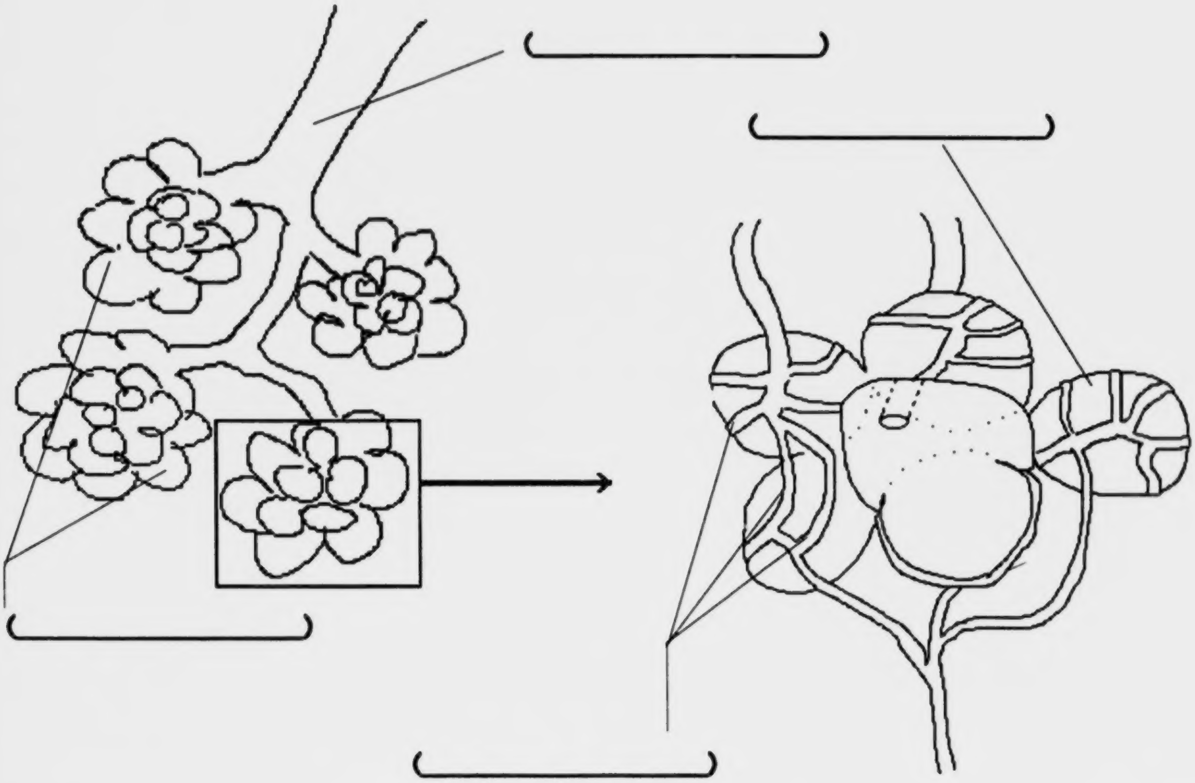
3. Emphysema is disease associated with the air sacs. Investigate and explain the causes of this disease? Describe the damage to the air sacs brought about by this disease.

4. Investigate the way that carbon dioxide is carried from the body cells to the lungs. How does it differ from the way oxygen is carried to the lungs

WORKSHEET — Mechanisms for Gas Exchange

Name ______________________ **Class** ________ **Date** __________

Part I: As you progress through the computer program, you will come to a section called the air sacs. As you progress through that section, fill in the missing names on the diagram below.



Part II - Completion Questions

1. The bronchi terminate in structures called ______________
2. The alveoli are surrounded by a network of capillaries called the __________________ capillaries.
3. Each air sac is composed of many __________________.
4. The air we inhale has more ______________ than the air we exhale.
5. The chemical in the blood to which both oxygen and carbon dioxide can bond is ____________________.
6. The two forms of hemoglobin found in the blood are known as _________________________ and __________________.

TOPIC 38
Malfunctions of the Respiratory System

Aim: What problems can occur in the human respiratory system

Performance Objectives: The students will be able to:

- state that carbon monoxide more readily combines with hemoglobin then does oxygen
- explain why the nicotine inhaled while smoking is harmful
- state that auto and industrial pollutants can cause lung damage and lead to chronic bronchitis
- describe how chronic bronchitis causes thickening of the walls of the bronchi and an excessive production of mucous
- state that chronic bronchitis can lead to infectious asthma
- describe the symptoms and causes of high altitude sickness
- explain that nitrogen narcosis can occur in scuba divers when the nervous system becomes saturated with nitrogen at depths greater than approximately 125 feet
- explain how scuba divers who ascend too quickly can suffer from bubbles of nitrogen forming within their bodies, a term called the "BENDS

Materials:

- IBM computer lab. using color monitors
- software package: Arrakis Advantage - Biology - Volume I by Prentice Hall (an identical software package is also available for Apple computers but was not tested)

Do Now:

Define these terms: carbon monoxide, nicotine, bronchi, bronchitis, nitrogen

Motivation:

Ask the students if they or any of their acquaintances have ever had any difficulty with their respiratory system. If the students are hesitant, point out that the common cold is an illness affecting the respiratory system, and that by now all the students in the class must have suffered from a cold at some point in their lives.

Development:

1. Write the names of the various illnesses or disorders of the respiratory system offered by the students in response to your motivational question.

2. Challenge the class to group the disorders listed on the board into two groups: one group caused by bacterial or viral infections and another group not caused by these infectious agents. Give the class assistance in ordering these two groups.

3. The largest group on the board should be the group of disorders caused by infectious agents. Explain to the class that this is because there are many different respiratory ailments caused by infectious agents. There are also many disorders of the respiratory system which have environmental or genetic causes, but they are not nearly as common as those brought

about by biological agents.

4. At this time explain to the students that you are about to teach them about several disorders of the respiratory system. Remind the students of the basic procedures of computer operation. Have the students turn on their monitors and then insert DISK I of the program into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to load. This software package is self loading.

5. The program commences with a picture of the heart and lungs. A short tune is played as two screens quickly introduce the name of the software and the publisher. When the music stops instruct the students to type the words "RESPIRATORY PROBLEMS" and then press the ENTER key. This procedure will open the program in the proper section to study the appropriate material for this lesson.

6. Allow the students a reasonable amount of time to operate and explore the program. It explains the symptoms of chronic bronchitis and explores briefly the dangers presented by nicotine. It also covers the problems posed by air pollution. The program then proceeds to describe three respiratory problems associated with recreational sports. Following the instructional activity, the software will offer the students the opportunity to take a test which covers the entire respiratory system. If you have the time, you might consider allowing the students to test their knowledge of the respiratory system. These are 20 questions in the test.

7. In the event that the student has difficulty with the computer program, there are several options open to the student. If a student had difficulty understanding the concepts presented in the last few screens, the student may type the word REPEAT and then press the enter key. The last few screens will be repeated. If a student has forgotten a word or concept presented earlier in the program, the student can type DEFINE followed by the word or concept, and the press the enter key, e.g., DEFINE LUNGS. The word or concept will be explained again.

8. At the completion of the computer-guided instructional activity have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Explain the effect of carbon monoxide on hemoglobin.
2. Describe the harmful effect of nicotine.
3. Name two respiratory problems caused by air pollution.
4. Describe the effects of chronic bronchitis on the human body.
5. Explain the cause of nitrogen narcosis.
6. What is the "bends"?
7. How do you get the "bends"?

Homework:

1. Complete the assignment on the worksheet.

Enrichment:

1. Research some job-related disorders of the respiratory system. (Hint: begin your investigation with coal miners and asbestos workers)

2. How are divers who suffer from the "bends" treated? What happened to divers who suffered from the "bends" before this treatment was discovered?

3. Research divers have descended to depths of more than 1000 feet while breathing compressed "air". What measures have been taken to prevent them from suffering from the nitrogen narcosis?

WORKSHEET — Malfunctions of the Respiratory System

Name ______________________ Class ________ Date __________

Part I: Completion questions.

1. The gas which combines more readily with hemoglobin than does oxygen is ____________________.

2. ____________ ____________ is a disease which can be cause by air pollution.

3. The chemical, found in cigarettes, that has an adverse effects on the respiratory system is ______________.

4. If not treated, chronic bronchitis can lead to ______________ .

5. Mountain climbers who ascend to great heights must carry _______________ with them to prevent high altitude sickness.

6. __________________ is an occupation that may expose individuals to the dangers of high altitude sickness?

7. The "bends" occurs when ___________ of nitrogen form in the blood vessels and joints.

8. Nitrogen narcosis affects the ______________ system and causes disorientation.

9. Divers can suffer from nitrogen narcosis when they descend to depths of _________ feet or more.

10. _____________________ is a common viral infection of the respiratory system.

Part II. Answer the following questions

1. Describe the effect that chronic bronchitis has on the walls of the bronchi.

2. Is severe coughing a symptom of chronic bronchitis? Explain.

TOPIC 39
Respiratory and Mucous Functions

Aim: What are the structures and functions of the human respiratory system?

Performance Objectives: The students will be able to:

- recognize the parts of the respiratory system
- locate and describe the functions of the organs of respiration such as:
    a. nostrils
    b. windpipe
    c. bronchi and bronchioles
    d. lungs and air sacs
    e. diaphragm
- understand the role of mucus in breathing

Materials:

- Apple IIe computer lab (color monitor recommended)
- software: The Human Body: An Overview, publisher: BrainBank Inc.
- model or chart of the human respiratory system

Do Now:

Why must we breathe to survive?

Motivation:

Tell students to hold their breath. How long can they maintain holding their breath before they must breath again?

Development:

1. Discuss motivation activity with the students. Ask why couldn't they control their organs of respiration longer.

2. Tell students that the program they are about to use will teach them about the parts of the respiratory system, their function and how they help us in our everyday activities. Display the chart and introduce the students to the respiratory system.

3. Remind the students of the correct procedure in handling software and to make sure the <Caps Lock> is pushed in. Insert the disk into drive 1, close drive, turn monitor and computer power on. The program is self-loading.

4. When the menu appears, instruct students to select option #6, The Respiratory System.

5. As the lesson progresses students have many opportunities to interact with the software by responding to a variety of questions.

6. Allow 30 minutes to complete the lesson.

7. Upon completion of the software portion of the lesson advise students to remove the disk, place it in its protective sleeve and turn the computer and monitor off.

Summary:

1. List the parts of the respiratory system.
2. Which is the preferred site for air to enter our bodies? Why?
3. Which involuntary muscle aids respiration?
4. Compare and contrast the bronchi and the bronchial tubes.
5. Why is mucus important to respiration?
6. How do we remove the carbon dioxide from our lungs?
7. Is it easier to control inhalation or exhalation? Why?

Homework:

1. Draw and label a diagram of the respiratory system.
2. Name the three functions of the respiratory system.
3. What are the lungs made up of?
4. What role do the ribs have in respiration?
5. How do we exhale?
6. Trace a molecule of oxygen on its path through the respiratory system, from the time it enters the nostril.

Enrichment:

1. Make a note of your respiratory rate at rest. Run in place for five minutes. Take your respiratory rate and note again. Compare.
2. Compare your active and at rest respiratory rates with those of several of your classmates. What conclusions, if any, can you draw?

TOPIC 40

Factors Affecting Breathing Rate

Aim: What factors influence our breathing rates?

Performance Objectives: Students will be able to:

- design and conduct experiments measuring the rate of respiration using a microcomputer for data aquisition and recording.
- explain how breathing rate measurements can be made using a thermistor probe and microcomputer
- explain what factors control breathing rate

Materials:

- Apple computer with large display monitor or Apple computer lab
- Apple DOS 3.3
- laboratory hardware - HRM MICRO/scope box and probes, connecting wires
- software: Experiments in Human Physiology by HRM software
- rexographed lab sheets
- rubbing alcohol (70% alcohol) and cotton swabs
- watch with sweep second hand
- masking tape or adhesive tape
- a milk crate or other platform approximately 12 inches tall.

NOTE: The hardware should be connected to each computer prior to the start of this lab activity. Instructions are included within the software documentation.

Do Now:

Use your watch or the classroom clock to determine the number of times you breathe in one minute. Record this number. Count the breathing rates of two other classmates by observing the movement of their chests. What is the range of respiration rates that you observed?

Why is it a good idea to understand the expected values for a series of experimental measurements prior to conducting the actual measurements?

Motivation:

Display a single Apple computer equipped with the HRM MICRO/scope box and hardware for temperature measurement. Load the software "Experiments in Human Physiology." Display the temperature probe and challenge the students to develop a method for measuring breathing rates using the temperature probe. Elicit that you can measure the temperature of air entering and leaving a person's nose. Select a student subject and additional volunteers. Instruct the volunteers to hold the probe in front of the subject's nose. To start recording data select option #4 - Respiration Rate from the main menu. Then enter "S" (start) and strike the "return" key. The program will graph the variations in air temperature and perform the calculations. It will then plot the respiration rate in breaths per minute on the lower part of the screen. To end the measurement cycle hold the ESC key until the 14 second measurement cycle is completed.

The Respiration Rate experiments can be performed as a laboratory activity with the students working in groups or can be performed as a demonstration using a single computer and several volunteers.

Development:

1. Ask the students to suggest one or more experiments that can be performed using the computer to monitor and record respiration rates. Suggested activities for experimentation include exercise, biofeedback, exposure to an experimental stress, etc. List these experiments on the board and discuss the procedures that could be used to perform each of the experiments.

2. Distribute the laboratory worksheet and explain to the students that they will perform an experiment to determine the effects of exercise on breathing rates.

3. Select a volunteer subject and instruct the subject to sit quietly for several minutes. Wash the probe with alcohol and attach it to the student's face using the tape so that the thermistor is directly in front of the nose. Be sure that the probe tip is not touching the skin. Start the program to insure that the probe is recording temperature changes corresponding with breathing.

4. Record the respiration rate while the student is sitting and resting. Instruct the student to breathe naturally while the measurements are being taken. The data should be recorded for two to three minutes.

5. Instruct the student to stand up and perform the step test exercise. Instruct the student to step up onto the box and then step down off the box at a rapid rate for two minutes. Continue to record data during this time period. At the conclusion of the exercise instruct the subject to sit down and continue to record data until the breathing rate stabilizes. Do not permit a student who is medically excused from gym to perform this activity.

   If time permits allow the students to conduct a set of readings on a second subject. Wash the probe with alcohol prior to conducting the second set of measurements.

6. Experiment 2 - Effect of breath holding on breathing rate.
   Select another volunteer and connect the probe for measuring respiration rates. Record data for two to three minutes while the subject is sitting and resting. Instruct the student to stop breathing and hold the breath for as long as possible. Continue to record data during the period of breath holding and during the recovery that follows.

7. If time permits the class can conduct other experiments. Use the initial list of student suggestions.

8. At the conclusion of the computer activity, instruct the students to disconnect the probes and wash them with alcohol and place the diskettes back into their protective envelopes, close the disk drive doors and shut off the machines.

Summary:

1. What factors cause changes in the breathing rate of a healthy person? Why?
2. What is the range of respiration rates that should be found in a healthy human being? Why is the measurement of respiration rate used as a tool for diagnosing illness?
3. How does conscious control influence breathing rate? Is the respiration rate under voluntary control or is it involuntary? explain?
4. What variations would you expect to find if you can monitor a person's respiration rate for a 24-hour period?

Homework: Use your biology textbook to help you complete this assignment.

1. Describe the mechanisms that regulate or control the rate of respiration in humans.
2. What is the relationship between body size and rate of respiration? Study the respiratory rates of small animals such as hummingbirds or mice and compare the data with the respiratory rates of whales and elephants. How does the breathing rate of a healthy infant compare with the rate of an adult?

Enrichment:

1. Develop an experiment to show how changes in the breathing rate can cause changes in the pulse rate. Perform the experiment and report the results to the class.
2. Psychological stress can cause changes in respiration. How are measurements of these changes used in lie detection equipment (polygraphs)?

WORKSHEET — Factors Affecting Breathing Rate
Student Respiration Rate Data Sheet

Name ____________________ **Class** ________ **Date** __________

Self Measurement __________ breaths/minute

visual observations

1. __________________
2. __________________
3. __________________

Observations using computerized data acquisition

trial#	breaths recorded on screen	calculated respiration rate
1.		
2.		
3.		
4.		

Respiration rate exercise experiment

Subject __________________

recorder __________________

Record data at one minute intervals

		reading time	respiration rate
Resting rate reading	#1		
	#2		
	#3		
exercise readings	#1		
	#2		
	#3		
recovery readings	#1		
	#2		
	#3		

TOPIC 41
Adaptation for Excretion in Plants

Aim: How do plants eliminate their by-products?

Performance Objectives: The students will be able to:

- recognize the formula for photosynthesis
- describe the raw materials required for photosynthesis and the bi-products that are produced as a result of the chemical reactions
- explain how the diffusion of gases in and out of a leaf is controlled by the stomates
- describe the structures and functions of the chloroplasts and guard cells
- describe how varying concentrations of glucose and water control the opening and closing of the stomata
- describe why the stomata are open during the day when photosynthesis occurs and closed at night

Materials:

- MS-DOS computer lab, color monitors
- Software: Exploring That Amazing Food Factory, The Leaf by Thoroughbred Educational Software, Disk #2
- An assortment of green plants
- prepared slides of leaf tissue showing stomata
- several microscopes
- large poster of the oxygen-carbon dioxide cycle

Do Now:

What is the source of the oxygen in the air? How does our present atmosphere compare with that of the primeval earth?

Motivation:

1. The teacher should place the formula for photosynthesis on the board.

$$\text{Energy} + 6(\text{carbon dioxide}) + 6(\text{water}) \underset{\text{respiration}}{\overset{\text{photosynthesis}}{\rightleftharpoons}} \text{glucose} + 6(\text{oxygen})$$

2. What are the products that result from the process of photosynthesis? Assist the students in reading the formula and elicit from the students that both glucose and oxygen result from the chemical processes that occur. What happens to the glucose? What about the oxygen?

   Elicit that the plant uses the glucose as a source of nutrition and the oxygen is given off by the plant. Elicit that oxygen is a by-product that results from photosynthesis. The teacher should use the poster of the oxygen cycle to emphasize the fact that plants give off oxygen when undergoing photosynthesis.

3. What are the products that result from the process of respiration in plants? Assist the students in reading the formula from right to left, as indicated by the arrow representing respiration. What substances

are required for plants to perform respiration? What are the by-products of the process of respiration in plants?

Discuss the relative quantities of oxygen produced during photosynthesis and consumed during respiration and also inform the students that respiration is a continuous process while photosynthesis occurs only when a plant is receiving light energy.

Development:

1. Display the green plants and ask the students to identify the structures that enable a plant to take in carbon dioxide and give off oxygen. Elicit or assist the students in developing an understanding that the openings, called stomata, are located on the bottom surfaces of the leaves and are very small.

2. Allow the students to have several minutes to view the prepared slides of the stomata and draw sketches of the observed structures. To assist the students in viewing the stomata, the microscopes should be adjusted and focused prior to the start of the lesson. Have the students come up in groups. It may be necessary for the teacher to designate monitors to remain at the microscopes and readjust the focus to insure that all of the students have an opportunity to view real stomata.

3. After all of the students had an opportunity to view the stomata inform the students that they will use the computers to learn more about the structures found in leaves and the biproducts that result from photosynthesis.

   PRIOR TO THE FIRST USE OF THIS PROGRAM THE TEACHER SHOULD PREPARE SELF-LOADING DISKS. THIS REQUIRES THAT THE TEACHER TRANSFER A COPY OF DOS (DISK OPERATING SYSTEM) ONTO EACH OF THE PROGRAM DISKS. THE INSTRUCTIONS FOR THIS PROCESS ARE CLEARLY EXPLAINED IN THE DOCUMENTATION. THE TEACHER SHOULD ALSO PREPARE A BACKUP COPY OF EACH OF THE PROGRAM DISKS AND STORE THE ORIGINAL PROGRAM DISK AS AN ARCHIVE COPY.

4. Distribute the software. If the students are not familiar with the operation of the computers, inform them that they should not bend or fold the disks and should not place anything but the diskettes into the disk drive.

5. Instruct the students to insert the program disk #2 into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. If DOS was placed on the program disks they will self-load and the students will be presented with the title screen and a menu.

6. Instruct the students to select section #1 - Exploring New Ideas. This short segment introduces the students to the key concepts and vocabulary used within the program. A scrambled message must be decoded after the vocabulary words have been decoded. This approach challenges the students to learn the vocabulary.

7. Instruct the students to press "ESC", the escape key, after they complete the introductory segment. This will return the program to the menu. Instruct the students to select "III - Action of the Stomates in Gas Exchange." This segment of the program will provide the students with the following information and activities:
    a. An explanation of how the diffusion of gases into and out of the leaf is controlled by the stomates. This segment of the program also reviews the functions of the chloroplasts and guard cells.
    b. The students are shown a typical leaf and a picture of magnified stomates. This segment shows the entry of carbon dioxide and water vapor and the exit of oxygen.
    c. Stomates - A Microscopic View: presents the students with a graphic representation of the stomates. The nuclei, guard cells and chloroplasts are labeled. This segment teaches the students that the opening and closing of the guard cells is caused by changing concentrations of water and glucose within the guard cells.
    d. Experiment - Changing the concentrations of water and glucose within the guard cells causes changes within the guard cells. The students view animated screens of the stomates opening and closing in accord with their selections of concentrations of water and glucose.
    e. Review and Action Quiz. The students are given a short review of the program and are given a quiz on the material that they have just learned. Instruct the students to complete this activity. In this quiz the students compete with the computer to try to answer the questions accurately in the shortest possible time. Students that did not grasp the material are given additional instruction and an additional opportunity to answer the questions.

8. At the conclusion of the computer activity, instruct the students to place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers and monitors.

Summary:

1. What substances are given off by a green plant during the process of photosynthesis?

2. What substances are given off by the cells in green plants as a result of the process of respiration?

3. How does the quantity of oxygen given off by a plant during photosynthesis compare with the quantity of carbon dioxide given off by the cells during respiration.

4. Some biologists classify oxygen as a plant by-product while others classify it as a "product." What would you call the oxygen given off by plant cells? Why?

Homework: Use your biology textbook to help you complete this assignment.

1. Draw a sketch of the stomata and guard cells from a typical leaf. Label the structures and explain the functions of each.

2. Describe the conditions that cause the stomata to open and close. How can plant structures open and close without the use of muscle tissue?

3. Why do plants require water? What adaptations prevent leaves from losing excessive amounts of water to the atmosphere?

4. What are the wastes that are given off by plants? What is the source of each of these substances?

5. Define transpiration? Is the water that is lost by a leaf during this process considered to be a plant waste product? Why or why not?

Enrichment:

Oxygen gas released into the atmosphere results from photosynthesis. Why do some biologists classify it as a "product" while others classify it as a by-product or a waste product?

TOPIC 42
Neurons and Nerves

Aim: What are the functions of the neurons?

Performance Objectives: Students will be able to:

- recognize neurons and label the parts of the nerve cells
- describe the functions of neurons
- explain how neurons transmit impulses

Material:

- Apple IIe lab
- software: Focus, "The Nervous System"

Do Now:

Define each of these terms: neuron, dendrite, axon, nuclear, cytoplasm, myelin sheath

Motivation: Questions

a. How do we send messages to different parts of the country?

b. Why does the body need a communications network which can carry messages like a telephone set?

c. How does the structure of the communications network in the human body compare with a phone system?

Development:

1. Insert software into the computer and turn on the machine. The program is self-loading.

2. Press N for no sound when menu appears.

3. Select #2 from the menu: No game (playing the game while answering the questions can used as a follow-up exercise at a later time).

4. Tell the students to press the enter key, then press #1. Allow a few minutes for students to read information placed on the screen by the computer. (Have students also press #2 and #3).

5. From the information provided by the computer in frames 1, 2, and 3, what can we say is the function of a neuron?

6. How does the dendrite help the neuron transmit impulses?

7. What is the function of the axon in this process? What structure covers the axon?

8. From what you're seen in frame #3 presented by the computer, is the axon well-suited to perform its function?

9. How does the dendrite's structure seem to help it function?

Summary:

1. How are neurons structured to meet their function?
2. What parts help the neuron function?
3. Distribute a related rexo diagram of neuron cell parts: axon, dendrite, cytoplasm, nucleus (This should be done in class).

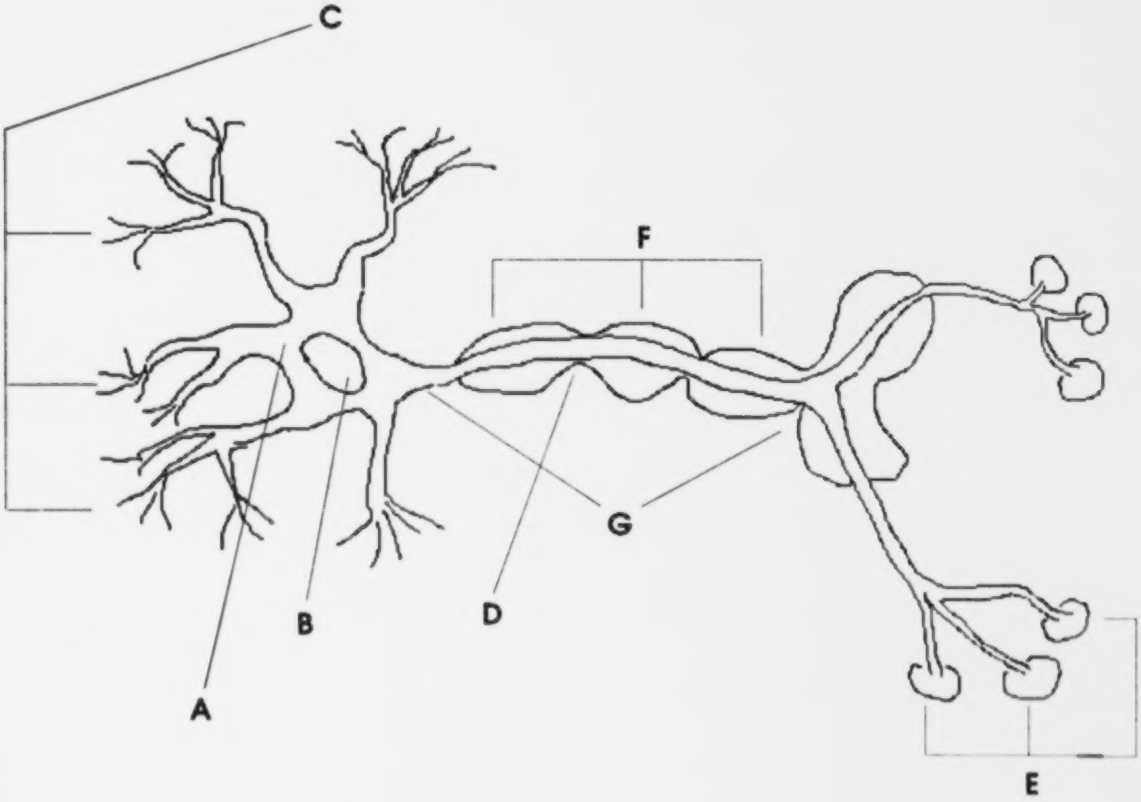
Homework: Rexo sheet. (Do questions 6-10).

Enrichment:

Have the students re-load the software, this time allowing them to select the game option.

WORKSHEET — Neurons and Nerves

Name ______________________ **Class** _______ **Date** _________



1. This structure carries impulses away from the cell body. ____________
2. This structure is responsible for the overall maintenance of the neuron cell. ____________
3. This structure surrounds the axon. ____________
4. This structure transmits impulses to the rest of the neuron after it receives them from other neurons. ____________
5. It is at this point that neurotransmitters accumulate to help impulses jump the synapse. ____________
6. This portion of the neuron contains the nucleus. ____________
7. List the structural names of the neuron as they are lettered in the diagram above.

A)______________ F)____________
B)______________ G)____________
C)______________
D)______________
E)______________

8. How does the release of neurotransmitters help transmit impulses? ____________
9. What effect does the myelin sheath have upon neuron impulses? ____________
10. What would happen if the myelin sheath was not present? ____________

TOPIC 43
The Three Major Types of Neurons

Aim: What are the structures and functions of the three types of neurons?

Performance Objectives: Students will be able to:

- identify and describe the three major neuron types
- understand how the three major types of neurons work together
- trace the path of an impulse across the three main nerve groups from a receptor to an effector

Material:

- Apple IIe lab
- software: Focus Media - The Central Nervous System
- rexo diagram
- chart or model of the human nervous system and neurons

Do Now:

define each term: receptor, effector, sensory neuron, interneuron, motor neuron

Motivation: Questions:

Can different computers communicate directly with one another?
What is the job of a computer interface?

Vocabulary: List on the board the following vocabulary:

stimulus, receptor, associative neuron, motor neuron
Note: The computer program utilizes the term "associative neuron" instead of interneuron.

Development:

1. Review student responses to the motivation and use the chart to illustrate how an impulse travels from a receptor to an effector.

2. Have students load up related software. When the computer screen presents the student with a choice regarding playing a game, type Y for yes. However the actual game in this phase of instruction will not be played. Instead, when the first question appears on the screen, students should press the H key. This will move them to the help mode. At this point students can select #4 and #5, where the most information regarding the topic will be found. When all students have #4 on their screens, the teacher should ask the students to think about the following questions:

   a. What is the job of the sensory neuron?

   b. What are the receptors, where are they located? Can you name some areas where receptors might be found?

3. Instruct students to turn to #5 by pressing the enter key. Allow groups time to observe this screen and use the information to answer the

following questions:

   a. What is the job of an associative neuron or interneuron?

   b. Where are associative neurons or interneurons found?

   c. What is the job of motor neurons?

4. Distribute work sheet, "The 3 Neuron Types".

   a. From your study, what type of neuron is neuron A? Why?

   b. Neuron B would most likely be found in what part of the body?

   c. Trace the path of a stimulus. Most likely such a stimulus would start at what point on your worksheet? Why?

   d. Most likely where would such a stimulus end up? Why?

Summary:

What are the 3 types of neurons in the human body? How does each function? Trace the path of each.

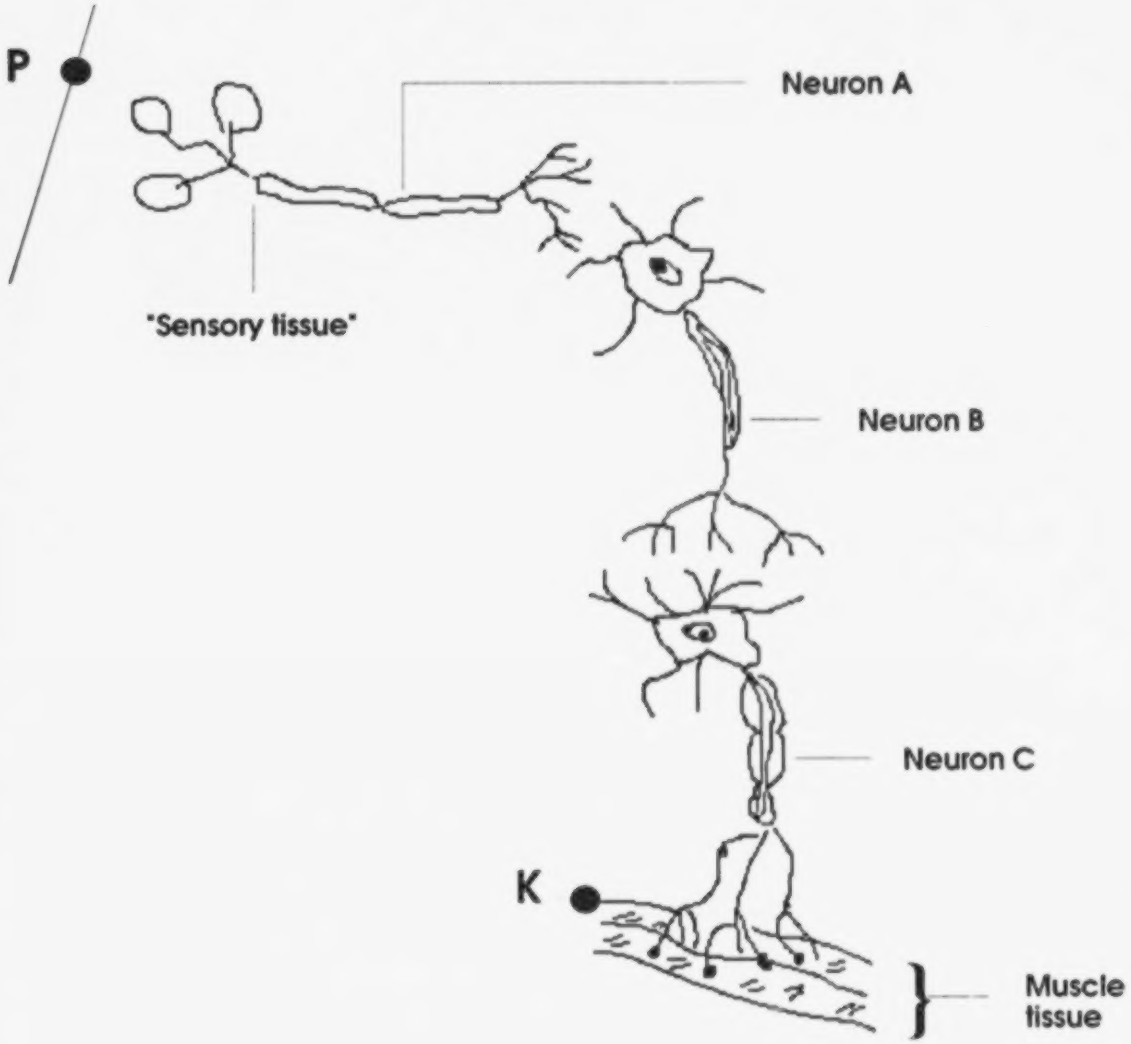
Homework:

Pick any one of the questions on the work, "Food For Thought" and briefly give an answer that has been carefully developed by you using some of the information in this lesson.

Enrichment:

Investigate the way in which impulses travel through neurons? What happens when the impulse reaches the synapse? What is the function of a neurotransmitter?

WORKSHEET — The Three Neuron Types


P
Neuron A
"Sensory tissue"
Neuron B
Neuron C
K
Muscle tissue

TOPIC 44
Nerve Cell Membrane and Impulses

Aim: How does the structure of a nerve cell help it to carry on the function of transmitting impulses?

Performance Objectives: Students will be able to:

- describe and locate the major structures of the nerve cell
- describe how a message is transmitted across a synapse

Material:

- Apple IIe lab
- software: Focus Media - The Nervous System
- rexo sheet

Do Now:

Define: synapse, neurotransmitter

Motivation:

From previous discussions and your own impressions, what invention would be most like a neuron? In what way is the passage of electricity across a wire most like a neuron? In what ways do you think it might be different?

Development:

1. Review student responses to the motivation. Introduce the term 'synapse' and describe what happens when an impulse reaches the synapse. Load Apple IIe with related software Focus Media's, "The Nervous System."

2. When program has appeared on the screen press N for no sound.

3. Select #2 from menu: No game (playing the game while answering questions can be used as a follow-up exercise at a later time).

4. Type in 20 questions, however, class will not use the questions at this point. Instead, this part of the program may be used as a follow-up exercise at a later time.

5. Have students press the enter key, then groups press #1. Allow a few minutes for class to review material printed on the computer screen. (Have students press the enter keys to study frames 2, 3, and 4.) Allow students about 10 to 15 minutes to review this material on their own.

6. Place the following words on the board: dendrite, axon, cytoplasm, nucleus, myelin sheath

   Then ask the following: Who can briefly describe the path of a neuron? Simultaneously with this question, the teacher should direct everyone to have frame #3 placed on the computer screen. Be sure to point out myelin sheath (not present in diagram).

7. When a stimulus is received by a neuron, what happens first within the neuron? What happens next?

8. When the message has completed its path along the neuron, ask how it reaches the next neuron cell.

9. If the class seems to be unsure at this point, direct students to frame #6 of the program.

10. What is the gap between neurons called?

11. What is the function of neurotransmitters in this process? How does arrival of an impulse at the axon affect the transmission of messages?

Summary:

Name the major structures of a neuron. When a message is sent across a neuron what part of the neuron receives it first, second, third? What causes a neuron to 'fire' or send an impulse?

Homework:

Using the diagram on this sheet describe in detail the passage of an impulse along the cell. Be sure to discuss the role of the following in the process: cytoplasm, nucleus, axon, dendrite, neurotransmitter, myelin sheath.

Enrichment:

Investigate the characteristics of a nerve impulse in detail. Discuss both the electrical and chemical changes that occur. Explain the term 'wave of depolarization.'

TOPIC 45
Growth in Plants

Aim: How does growth occur in plants?

Performance Objectives: The students will be able to:

- identify each structure of the root tip and describe its function: root cap, meristematic zone, zone of elongation, zone of maturation and root hairs
- describe the development of meristematic tissue into root hairs
- explain root hairs increase the surface area of the root and therefore increase the rate of water absorption
- describe the function of the root tip
- identify each structure of the terminal bud and describe its function: meristematic zone, zone of elongation, zone of maturation and the young leaves
- describe the development of meristematic tissue into palisade cells
- describe the phototropic response in plant stems and explain how light distribution affects the distribution of auxin in growing plant stems
- identify the structures of a "woody" stem and describe the functions of each

Materials:

- MS-DOS computer labs, DOS disks
- software: Plant Growth and Specialization, IBM Software
- large chart or model of a root tip
- large chart or model of a stem and terminal bud
- cross-section "slice" of a tree trunk
- living plant roots and hand lenses (optional)
- worksheet containing diagrams of root tip, terminal bud and woody stem

Motivation:

1. The teacher should display the root tip model and ask students: How does growth occur at the root tips of a plant? What structure protects the tender new cells as the root penetrates hard soil?

   Elicit student responses and ask students: At which other sites does growth occur in plants? The teacher should elicit that growth occurs at the terminal buds and at the cambium layer. The teacher should display the models or charts and indicate the locations where meristematic tissue is located.

Development:

1. The teacher should review student responses to the motivation and insure that the students are aware of the locations where plant growth occurs. The teacher may also wish to review the vocabulary activity from the previous lesson prior to introducing the computer activity.

2. The teacher may wish to have a student uproot a plant and have the students view the roots and root hairs using a hand lens (magnifying lens). This can be done by calling upon the students to come up to the lab table in small groups.

3. Distribute the software and the DOS disks. If the students are not familiar with the operation of the computers inform them that they should not bend or fold the disks and should not place anything but the diskettes into the disk drive.

4. If this is the first use of this program the teacher should prepare a self-starting diskette. The teacher should first prepare a back-up copy of the diskette and follow the instructions included within the documentation to transfer DOS onto the back-up copy of the program disk.

5. Instruct the students to insert the program disc into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. If a self-loading diskette was prepared the program should load automatically and present the students with a title screen and a menu. Instruct the students to select section 111 - Root Tip and Terminal Bud Growth

6. This program starts running by presenting the students with an excellent diagram of a root tip and an explanation of the structures present and their functions. Midway through this explanation an animated screen illustrates how meristematic tissue at the root tip develops into root hairs. The program explains how the root hairs increase the surface area of the roots and their ability to absorb water. The students are then presented with a review and a quiz which consists of six matching type questions on the functions of root tip structures. If a student has more than two errors a "learning loop" provides the student with review and another opportunity to take the quiz.

7. The program then offers the students a segment on the terminal bud. The program presents the students with a cross-section view and also shows the students, through the use of an animated diagram, how meristematic cells develop into palisade cells which can perform photosynthesis. This segment is followed by a four question quiz on the terminal bud. At the conclusion of the quiz, the students are presented with the option of continuing or quitting. Instruct the students to select "C" (continue).

8. The fourth section of the program starts by presenting the students with information about Darwin's experiments with oat seedlings. The program uses an animated screen to illustrate how the seedlings respond to a light source held directly overhead and when it is moved to one side of the plant. The students are then shown what happens to the growth of the stem after the stem tip is removed. The students are introduced to Boysen-Jensen's experiments which illustrate how auxins are responsible for differential growth. These experiments involved the insertion of a piece of mica into the stem to modify the flow of auxins. The students are then presented with an excellent cross-section diagram of a "woody" stem and are introduced to the following structures: wood, bark, cambium, pith, xylem, and phloem. As the students work their way through this segment they are presented with an animation which illustrates how cambium meristematic cells develop into xylem and phloem tissue and also the relative locations of the two types of tissue. At the completion of this segment the students are offered a review which includes definitions of tropism and phototropism. The students are then given a four question fill-in quiz on the structures of the woody stem. If the students make two or more errors a "learning loop" returns them to the material that

was just completed for review. At the conclusion of this activity the students are presented with the choice of continuing their study or quitting.

9. The students should be instructed to type "Q" (quit).
10. At the conclusion of the computer activity, instruct the students to place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers and monitors.

Summary:

1. How does growth occur at the root tip, terminal bud and within a woody stem?
2. Distribute the worksheet and have the students label the parts of each structure and describe the functions where indicated.

Homework: Use your biology textbook to help you complete this assignment.

1. Why is it harmful to cut your initials into the bark of a tree?
2. Where does growth occur in "woody" tree trunks?
3. Trees growing in regions that have cold winters exhibit growth rings. Write a short report describing the formation of these rings and explain how these rings can be used to determine the age of the tree.

TOPIC 46
Hormones and Growth Response in Plants

Aim: How do hormones influence the rate of growth in plants?

Performance Objectives: The students will be able to:

- define specialization
- describe the way that undifferentiated meristematic tissue develops into tubular and vacuolated cells
- define and explain the function of xylem, phloem and cortex tissue
- define auxin and identify the sites of auxin production in plants
- interpret a graph showing the effects of varying auxin levels on root and stem growth
- define gibberellin and describe several differences between auxins and gibberellins
- describe the causes and results of tropisms
- describe experiments that were performed to show that auxins were responsible for phototropisms

Materials:

- MS-DOS computer labs, DOS disks
- software: Plant Growth and Specialization, IBM Software
- large chart of model of a root tip
- large chart or model of a stem and terminal bud
- package of rooting hormone
- several stems from a plant removed for use as cuttings, a flower pot of sandy, moist soil.

Do Now:

How do you start plants from cuttings?

Motivation:

1. Display the package of rooting hormone and several cuttings. The teacher should call upon a student to come to the front of the room, read the directions on the package and follow the instructions to plant the cuttings.

   Ask: Why should rooting hormone be placed on cuttings before they are planted?

   Elicit student responses and place them on the board.

Development:

1. Define the term "hormone" and explain that hormones can be used to stimulate, regulate, or control activities in living organisms including the rate of growth in plants.

2. Introduce the computer activity and inform the students that they will use the computers to learn how growth occurs in plants and how hormones regulate and control the rate of growth in plant roots and stems. The teacher should give the students 20-25 minutes to complete this activity.

3. Distribute the software and the DOS disks. If the students are not familiar with the operation of the computers inform them that they should not bend or fold the disks and should not place anything but the diskettes into the disk drive.

4. Prior to the first use of this program the teacher should prepare a self-starting diskette. The teacher should first prepare a back-up copy of the diskette and follow the instructions included within the documentation to transfer DOS onto the back-up copy of the program disk.

5. Instruct the students to insert the program disk into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. If a self-loading diskette was prepared the program should load automatically and present the students with a title screen and a menu.

6. This program starts running by presenting the students with several screens of text which provide information on plant growth, cell division and specialization and the way in which undifferentiated meristematic tissue develops into phloem, xylem and cortex. The program then quizzes the students (three questions) on the functions of the phloem, xylem and cortex. The program then provides the students with information on the locations on a plant where undifferentiated tissue can be found. The program informs the students that undifferentiated meristematic tissue can be found at the root tips, terminal buds and the cambium. The students are then presented with a stick figure type animation which traces the development of roots, stems and leaves from a germinating seed. This segment illustrates the changes that occur at the root tips, cambium and terminal buds. The students are then presented with a review and a quiz which consists of four fill-in type questions on the functions of phloem, xylem and cortex tissue. If the students make two or more errors a "learning loop" returns them to the material that was just completed for review. At the conclusion of this activity the students are presented with the choice of continuing their study or quitting.

7. Instruct the students to type C for continue. They will be presented with the start of section 2 - Plant Hormones. This segment begins by introducing the students to auxins and gibberellins, the two types of plant hormones. The students are then taught that auxins are produced by root tips, stem tips, leaves and flowers. The students are informed that auxins can either stimulate or inhibit plant growth. The program also shows the students how auxins are produced in one part of a plant and transported to other parts.

8. The program presents the students with a simulation in which the students can observe the effects of varying concentrations of auxins on the growth of roots and stems. The program presents the students with a line graph showing the auxin concentrations and rates of growth for both stems and roots. The students are presented with a series of questions which give them practice in reading and interpreting graphs on growth rates and hormone levels.

9. The students are presented with additional information on auxins and are informed that hormones can also affect the formation of fruit, the pattern of flower opening and tropisms. The students are introduced to indole acetic acid, the most common naturally occurring auxin and are also informed that synthetic auxins are used to stimulate root growth in cuttings, produce seedless fruit inhibit sprouting in stored potatoes and to kill weeds. The students are then presented with information on gibberellins. They are informed that gibberellins only affect the growth of stems and affect both the growth rate of cells and the rate of cell division. This segment of the program ends with a short quiz and the option to continue or quit. Instruct the students to select "Q" (quit).

10. At the conclusion of the computer activity, instruct the students to place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers and monitors.

Summary:

1. Where does growth occur on plants?
2. Describe the process through which undifferentiated meristematic tissue develops into specialized plant cells.
3. What are the functions of phloem, xylem and cortex tissues?
4. What are the sources of plant hormones?
5. How do auxins and gibberellins influence the growth rates of plants?
6. How can farmers use plant hormones?

Homework:

Use your biology textbook to help you complete this assignment. Define each of these terms and use each word in a sentence.

a. undifferentiated tissue
b. meristematic tissue
c. phloem
d. xylem
e. cortex tissue
f. root tip
g. root cap
h. hormone
i auxin
j. gibberellin
k. tropism

Enrichment:

Develop an experiment to show the effects of auxins on plant growth. Clearly identify the procedures that should be followed, the variables in the experiment and the hypothesis which you are testing.

TOPIC 47
The Role of Skin in Regulating Temperature

Aim: What factors cause changes in skin temperature?

Performance Objectives: Students will be able to:

- design and conduct experiments measuring variations in skin temperature using a microcomputer for data aquisition and recording
- explain how temperature measurements can be made using a thermistor
- determine the range of skin temperature values at different sites on the body
- explain how the skin serves to regulate and control human body temperature
- determine the variations in skin temperature that result from physical activity, exposure the warm and cold environments and other experimental conditions

Materials:

- Apple computer with large display monitor or Apple computer lab
- Apple DOS 3.3
- laboratory hardware - HRM MICRO/scope box and probes, connecting wires
- software: Experiments in Human Physiology by HRM software
- rexographed lab sheets
- rubbing alcohol (70% alcohol) and cotton swabs
- clinical thermometer

NOTE: The hardware should be connected to each computer and the probes should be calibrated prior to the start of this lab activity. Instructions are included within the software documentation.

Do Now:

What factors may cause changes in human body temperature?
Why is an abnormal body temperature often used to detect illness?

Motivation:

1. Display the clinical thermometer and ask the students: What is the source of heat within the human body? What is the normal range of human body temperature? What serves to control or regulate body temperature?

2. Discuss student responses and elicit that human beings produce heat during the process of cellular respiration. Introduce the term "homeostasis" and describe the mechanisms which are used to maintain a stable body temperature. Discuss the roles of the skin in cooling an overheated body through the evaporation of perspiration and maintaining heat in a cold environment through reduced circulation of the blood in the vessels within the skin.

3. Display a thermistor probe and a computer and explain that a thermistor is an electronic device which can be used to measure temperatures electronically. Explain that the voltage which flows through the thermistor probe varies with temperature. The computer can detect the

changes in voltage and print or record the corresponding temperature. Explain that prior to their initial use the probes must be calibrated.

THE CALIBRATION INSTRUCTIONS ARE INCLUDED WITH THE SOFTWARE. THE PROBES AND SOFTWARE MAY BE CALIBRATED TO USE EITHER CELCIUS OR FAHRENHEIT DEGREES.

4. This activity can be performed as a laboratory activity, with the students working in groups or can be performed as a demonstration using a single computer and several volunteers. Place the disk in the drive and turn on the computer and monitor. When presented with the main menu instruct the students to select 3 - Skin Temperature. Set the time range for the experiment to three minutes and the range of temperature for 20-40 degrees Celcius. Start the program by pressing "S" and the return key to start the program. Touch the tip of the probe to various objects and watch the changes in temperature appear on the screen. Explain to the students that in order to get accurate readings it is necessary to hold the probe in place until the reading stops changing. After the students are familiar with the operation of the equipment distribute the laboratory sheets and start the experiment.

5. ACTIVITY 1-CONSTRUCT A MAP OF SKIN TEMPERATURE

   A. Select a student volunteer to serve as the subject of the experiment and a team of students to take the readings and record the data. Instruct the subject to take off one shoe and sock and sit quietly for several minutes prior to the measurements. Wash the temperature probe with alcohol prior to taking the readings.

   B. Measure and record the subject's skin temperature at each of these body sites: tip of thumb and little finger, palm of hand, back of hand, over radial artery (pulse point), inside of forearm, under the arm (axilla), tip of nose, forehead, earlobe, back of neck, over carotid artery (neck), top of head, tip of toe, inside surface of the ankle.

      If time permits allow the students to conduct a set of readings on a second subject. Wash the probe with alcohol prior to conducting the second set of measurements.

   C. Ask the students: What body sites produced the highest and lowest readings? What is the relationship between the temperature readings that were recorded and the location of major blood vessels? What variations occurred in the measurements conducted on different people?

6. Experiment 2 - Determination of the effect of physical activity on skin temperature.

   A. Select a subject that has been resting and record the skin temperature over the biceps muscle. Instruct the student to do 20 or more pushups. Immediately following the exercise record the skin temperature over the muscle and continue graphing the temperature for several minutes. DO NOT PERMIT STUDENTS MEDICALLY EXCUSED FROM GYM TO SERVE AS SUBJECTS FOR THIS EXPERIMENT.

B. What caused the temperature change that was observed? Why does physical activity cause an increase in body temperature? What regulatory processes cause an increased metabolic rate, increased heartbeat and respiration rates and increased temperature when a person exercises?

C. Did the subject exhibit any physiological responses that indicated that the body was attempting to lose excess body heat? What would happen to the temperature of the subject if the exercise was continued for a prolonged period of time?

8. At the conclusion of the computer actvity, instruct the students to disconnect the probes and place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers.

Summary:

1. What factors cause changes in the body temperature of a healthy person? Why?
2. Why do variations in body temperature occur when the temperature is measured at different sites?
3. What are the mechanisms that help to maintain a stable internal body temperature?

Homework: Use your biology textbook to help you complete this assignment.

1. Describe the process of thermoregulation that occurs in humans? What are the functions of the nervous system in this process?
2. How does clothing help to keep us warm in the winter? What types of clothing are most effective? Why?

Enrichment:

1. Obtain an oral thermometer and learn the correct procedures for taking an oral temperature. Record your body temperature when you first wake up and continue to take readings at two-hour intervals throughout the day. Take the last reading at night before going to sleep. Plot a line graph showing the variations in your body temperature. Write a report on the changes that you have observed. What is the cause of the daily variation that occurs in body temperature?
2. Investigate the use of thermal photography of the human body as a diagnostic tool. How can a temperature map of the body be used to locate tumors, infections and other problems.

WORKSHEET — Skin Temperature Measurement

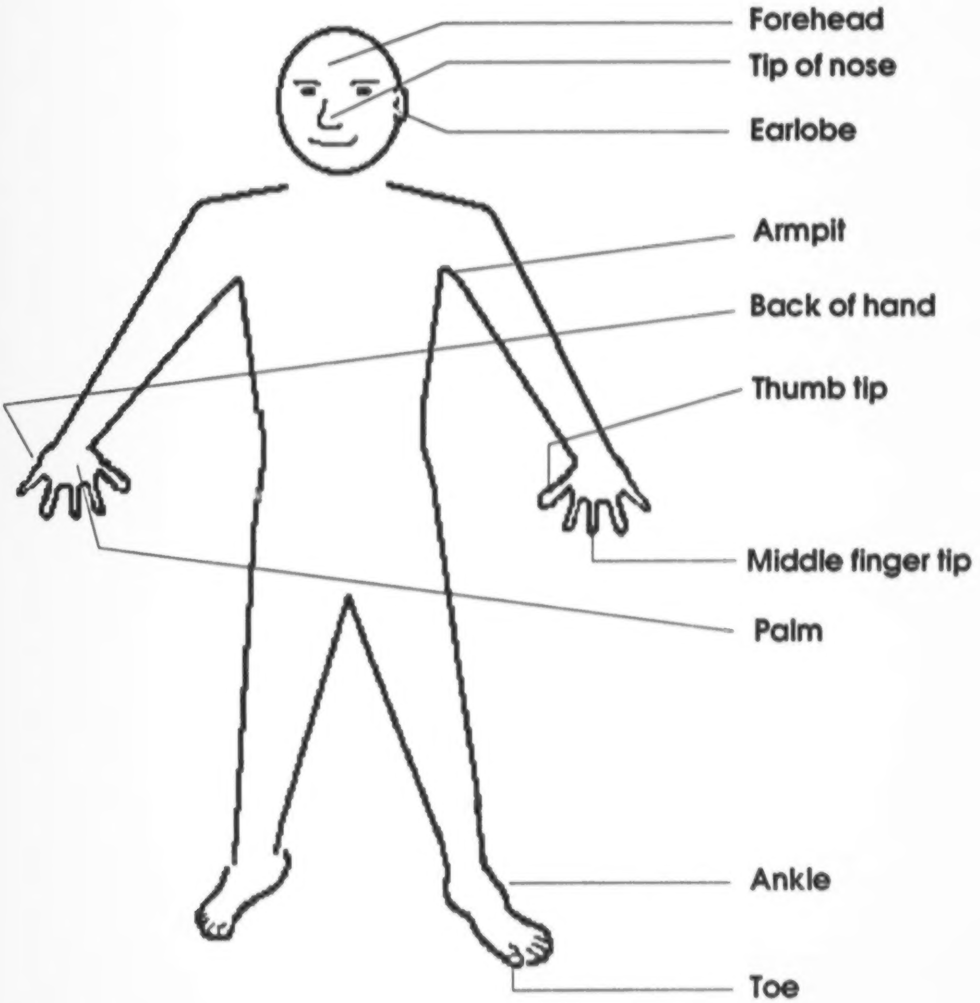
Date: ____________________

Data Recorder: ____________________

Subject: ____________________

MAP of skin temperatures of the body

Record the temperature readings on the map. Add any aditional measurements which you perform.


Forehead
Tip of nose
Earlobe
Armpit
Back of hand
Thumb tip
Middle finger tip
Palm
Ankle
Toe

TOPIC 48
The Human Skeletal System

Aim: What are the structures and functions of the human skeletal system?

Performance Objectives: The students will be able to:

- recognize the parts of the skeletal system
- locate and describe the functions of the skeletal system parts
- explain the functions of the various major bones of the skeleton
- appreciate the importance of ligaments
- understand the role of cartilage
- respond to software-generated questions

Materials:

- Apple IIe computer lab (color monitor recommended)
- software: The Human Body: An Overview, published by BrainBank Inc.
- chart of the skeletal system
- simple lever

Motivation:

Tell students to look at chart. Relate the skeletal system to the frame of a building. How do the bones differ from the frame of a building? In what ways do the bones act as levers?

Development:

1. Discuss with students the similarities and differences between the frame of a building and our skeleton. List these on the board.

2. Tell students that the program they are about to use will teach them about the parts of the skeletal system, their functions and how they help us in our everyday activities.

3. Remind the students of the correct procedure in handling software and to make sure the <Caps Lock> is pushed in. Insert the disk into drive 1, close drive, turn monitor and computer power on. The program is self-loading.

4. When the menu appears, instruct students to select option 5, The Skeletal System. As the lesson progresses, students have many opportunities to interact with the software by responding to a variety of questions.

5. Allow 30 minutes to complete the lesson. Upon completion of the software portion of the lesson advise students to remove the disk, place it in its protective sleeve and turn the computer and monitor off.

Summary:

1. How many bones are in the human body?

2. What are the two major divisions of the skeleton?

3. Which bones make up the central skeletal system?

4. Describe joints and how they work.

5. Describe the functions of the following:
    a. the skull
    b. the ribs
    c. spinal column
    d. cartilage

Homework:

1. What are the two major bones of the skull?

2. Describe the role of the skeletal system.

3. Name the bones of the leg.

4. Name the bones of the arm.

5. What is the function of a ligament?

Enrichment:

1. Measure the length of your humerus bone. Compare the length of your humerus to that of your friends'. Relate this data to your height and that of your friends. What conclusions, if any, can you draw?

2. Why are X-rays an important tool?

TOPIC 49
The Human Muscular System

Aim: What are the structures and functions of the human muscular system?

Performance Objectives: The students will be able to:

- recognize the major parts of the muscular system
- locate and describe the functions of the muscular system organs
- discover the differences and similarities of the three types of muscle tissue
- understand the role of tendons
- explain why skeletal muscles must be arranged in pairs

Materials:

- Apple IIe computer lab (color monitor recommended)
- software: The Human Body: An Overview published by BrainBank Inc.
- chart of the human muscular system

Do Now:

What are the functions of the muscles?

Motivation:

Tell students to lift a book. Which muscles do the work involved? Call upon one or two students to point out the muscles that are contracting.

Development:

1. Discuss student responses to the Do Now and motivation questions

2. Tell students that the program they are about to use will teach them about the parts of the muscular system, their function and how they help us in our every day activities.

3. Remind the students of the correct procedure in handling software and to make sure the <Caps Lock> is pushed in.

4. Insert the disk into drive 1, close drive, turn monitor and computer power on. The program is self-loading. When the menu appears, instruct students to select option #2, The Muscular System, and also to select speed when prompted.

5. As the lesson progresses students have many opportunities to interact with the software by responding to a variety of questions. Allow 30 minutes for students to complete the lesson.

6. Upon completion of the software portion of the lesson, advise students to remove the disk and turn the computer and monitor off. Place the disk into its protective sleeve.

Summary:

1. Name the three types of muscle.
2. Which kind of muscle do we control?
3. Why do voluntary muscles usually work in pairs?
4. How are voluntary muscles attached to the bone?
5. Compare voluntary and involuntary muscle.
6. Describe cardiac muscle.

Homework:

1. Draw diagrams illustrating the three types of muscle cell.
2. Describe striated muscle.
3. What action can a muscle accomplish?
4. What is a tendon?
5. When does cardiac muscle rest?

Enrichment:

1. How many muscles does it take to blink one eye?
2. Make a list of the ways we may increase the strength of our leg muscles.
3. Select one of the above methods and test. Devise a method and compile data.
4. Write a short report on the skeletal muscles. Name the major skeletal muscles. Be sure to include the number of voluntary muscles found in the human body?

TOPIC 50
The Structure of the Human Digestive System

Aim: What are the structures and functions of the human digestive system?

Performance Objectives: The students will be able to:

- identify and explain the functions of each of the following parts of the digestive system: mouth, teeth, salivary glands, esophagus and stomach
- understand the importance of chewing properly
- describe what happens to food as it passes through the digestive tract
- explain why the digestive tract can be called the 'food tube'

Materials:

- Apple IIe computer lab (color monitor recommended)
- software: Disappearing Dinner - The Digestive System by Marshware
- human torso model or chart of the digestive system

Do Now:

Place the following questions on the chalkboard:
1- What did you eat for dinner last night?
2- What had to happen to that food in order for it to provide nourishment for your body?

Motivation:

Display the human torso model or chart and call upon one or more volunteers to explain what happened to last night's dinner using the model.

Development:

1. Discuss student responses to the "Do Now."

2. Tell students that the program they are about to use will teach them about the parts of the digestive system, their locations in the body and how they affect the food we eat.

3. Remind the students of the correct procedure in handling software and to make sure the <Caps Lock> is pushed in.

4. Insert the disk into drive 1, close drive, turn monitor and computer power on. The program is self-loading.

5. Tell students to type in a first name and a two-place code when prompted. Whenever an asterisk <*> flashes, push <return>. To consult the dictionary for new vocabulary, push < ? >.

6. When the menu appears, instruct students to select option A. lesson #1. Allow 20 minutes for students to complete this section.

7. As the lesson progresses students have many opportunities to interact with the software by responding to a variety of questions.

8. When the students complete lesson #1 they will see a menu. Tell them to choose the lesson #1 quiz option. Allow five minutes to complete the quiz.

9. Upon completion of the quiz advise students to remove the disk, place it in its protective sleeve and turn the computer and monitor off.

Summary:

1. What happens if you do not chew your food properly?

2. Where is saliva produced?

3. Which food is dangerous for a baby to eat? Why?

4. Where is the esophagus located?

Homework:

1. Draw a diagram illustrating the parts of the digestive system we have studied in lesson one.

2. Label each organ and describe its function.

Enrichment:

1. Keep a log of the food you eat during the course of the next week.

2. Trace the path of each food as it is acted on by your digestive system. Indicate the nutrients that are supplied to the body by each food.

TOPIC 51
Functions of the Digestive System

Aim: How does food move through the human digestive system?

Performance Objectives: The students will be able to:

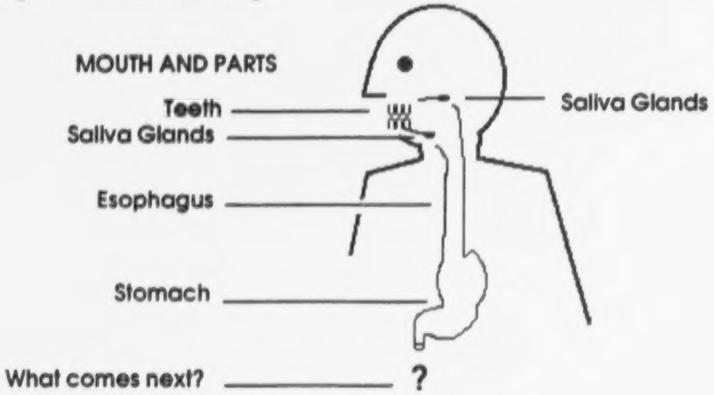
- trace the movement of food throught the digestive tract
- describe the enzymes that help to digest the food
- describe the composition of gastric juice
- describe the importance of pH in controlling digestion

Materials:

- Apple IIe computer lab (color monitor recommended)
- software: Disappearing Dinner - The Digestive System by Marshware
- litmus paper - blue and red; dilute acid and base

Do Now:

Place the following on the chalkboard:
1- A diagram illustrating:



2 - Is the food you ate for breakfast ready to provide energy for your body as it leaves your stomach? Why or why not?
3 - What must happen to the food next?

Motivation:

Demonstrate the effect of the acid and base on the litmus paper. Record the results on the board. What is the role of acid in human digestion? Where can a basic environment be found within the digestive system?

Development:

1. Discuss motivation diagram and questions with students.

2. Remind the students of the correct procedure in handling software and to make sure the <Caps Lock> is pushed in. Insert the disk into drive 1, close drive, turn monitor and computer power on. The program is self-loading.

3. Remind students to type in a first name and a two-place code when prompted. Whenever an asterisk <*> flashes, push <return>. To consult the dictionary for new vocabulary, push < ? >. When the menu appears, instruct students to select option C. lesson #2. Allow students 20 minutes to complete the lesson.

4. As the lesson progresses, students have many opportunities to interact with the software by responding to a variety of questions. When the students complete lesson #2 they will see a menu. Tell them to choose the lesson #2 quiz option. Allow five minutes to complete the quiz.

5. Upon completion of the quiz advise students to remove the disk and turn the computer and monitor off. Place the disk in its protective sleeve.

Summary:

1. Where does food in your esophagus go?

2. How is the food moved through the esophagus?

3. What happens to the pH of food as it enters the stomach?

4. What is the first thing your stomach does to food?

5. Why are muscles found in the stomach and small intestine?

6. Describe the small intestine and how it functions.

7. Name the enzymes found in the mouth, stomach and small intestine and explain what type of food each enzyme acts on.

8. What conditions are necessary for each enzyme to do its job?

Homework:

1. Add to the diagram illustrating the parts of the digestive system you drew for lesson #1. Include organ(s) we have studied in lesson #2. Also indicate the enzymes found in each organ.

2. Label each organ and describe its function.

Enrichment:

1. On a large sheet of paper have students trace each other's outlines.

2. Have students draw their own organs on the tracing. Carefully observe the location of the digestive organs.

3. Use a stethoscope to listen to the stomach and small intestine. Describe the sounds that you hear and indicate on the tracing where the sounds were heard. What do you think was the cause of the sounds?

TOPIC 52
The Intestines

Aim: What are the structures and functions of the intestines?

Performance Objectives: The students will be able to:

- describe the functions of the small intestine
- explain how nutrients are absorbed
- describe the structure and function of the villi
- explain what happens to undigested food in the large intestine

Materials:

- sugar and beaker filled with water
- large chart or model of the digestive system
- Apple IIe computer lab (color monitor recommended)
- software: Disappearing Dinner - The Digestive System by Marshware
- rexographed copies of worksheet

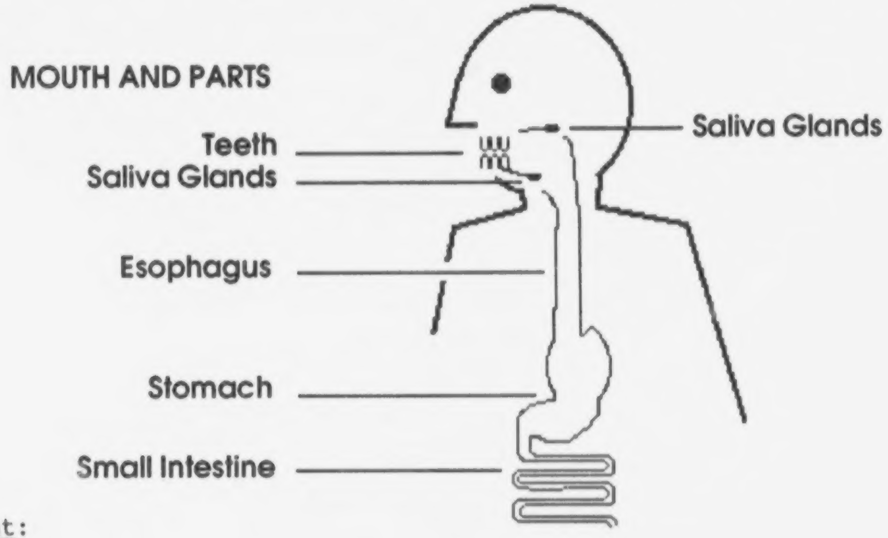
Do Now:

1. What happens to food in the small intestine?

2. What happens to the roughage that did not become soluble during the process of digestion?

Motivation:

Dissolve sugar in water. Ask the students: What happens to the nutrients that dissolve in the digestive juices? Why must nutrients dissolve into a solution?



Development:

1. Discuss motivation diagram and questions with students.

2. Tell students that the program they are about to use will teach them about the digestive system, how nutrients are absorbed and what happens to undissolved roughage.

3. Remind the students of the correct procedure in handling software and to make sure that the <Caps Lock> is pushed in. Insert the disk into drive 1, close drive, turn monitor and computer power on. The program is self-loading. Remind students to type in a first name and a 2-place code when prompted. Whenever an asterisk <*> flashes, push <return>. To consult the dictionary for new vocabulary, push < ? >.

4. When the menu appears, instruct students to select option E. Lesson #3. Allow students 20 minutes to complete the lesson.

5. As the lesson progresses, students have many opportunities to interact with the software by responding to a variety of questions. When the students complete lesson #3 they will see a menu. Tell them to choose the lesson #3 quiz option. Allow five minutes to complete the quiz.

6. Upon completion of the quiz advise students to remove the disk and turn the computer and monitor off. Place the disk in its protective sleeve.

Summary:

1. Where do dissolved nutrients go from the small intestine?

2. Why is the small intestine very long and covered with blood vessels?

3. What is the structure and function of the villi?

4. What is the main job of the large intestine?

5. Describe the large intestine.

6. What would happen if nourishment from the food we eat could not get to the red blood cells?

7. How are dissolved nutrients carried by the blood?

Homework:

1. Add to the diagram illustrating the parts of the digestive system you drew for lesson two. Include organ(s) we have studied in lesson three.

2. Label each new organ and describe its function.

Enrichment:

1. Write a short essay describing the importance of the digestive system to your everyday activities.

2. Analyze the log you began compiling as an enrichment activity in lesson one. Arrange the eaten foods into the following categories:
   a- meats
   b- dairy
   c- grains
   d- fruits and vegetables

   Indicate the nutrients each type of food supplies to the body.

Indicate the nutrients each type of food supplies to the body.
Why must we eat roughage if it supplies the body with no nutrients?
Are you placing a balanced diet into your digestive system?

3. Research and report on sound nutritional practices to be followed by teenagers.

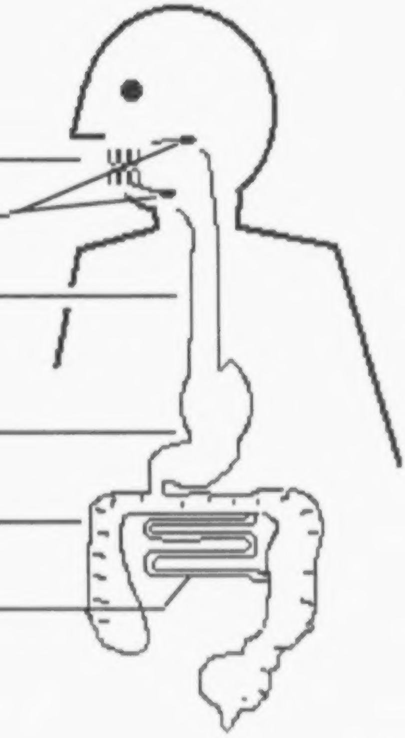
WORKSHEET — The Intestines

Name ________________________ Class ________ Date _________

(Use with lesson as additional reinfoircement)

Instructions: Fill in the numbered blank with the letter preceding the correct organ.

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________



A. esophagus
B. small intestine
C. stomach
D. salivary glands
E. large intestine
F. mouth

TOPIC 53
The Human Diet

Aim: How can we evaluate our individual diets?

Performance Objectives: The students will be able to:

- analyze their own diets to determine if they are getting the necessary nutrients
- determine whether their caloric intake is appropriate for students of their age, sex and activity level
- use product nutrition labeling to learn to identify both the types and quantities of nutrients provided by food products
- describe the role of each of the major nutrients within the human diet

Materials:

- MS-DOS computer labs, DOS
- software: a spreadsheet program
- USRDA nutrient tables or a teacher-prepared chart showing both the nutrients and the quantity/unit contained in most common foods.
- calorie charts containing most common foods
- several product packages or product labels which contain nutrition labeling
- student prepared lists of all of the foods, and the quantities that they have consumed during a 24-hour period.

NOTE: Prior to this lesson, the students should be assigned the task of recording all of the foods that they consumed over a single 24-hour period. This includes all meals, snacks and beverages. In addition the students should also record the approximate quantities. Inform the students of the goals of this activity and suggest that they can start determining both the caloric nutrient contents of the foods by reading the product labels.

Do Now:

What foods should we eat each day? Why?

Motivation:

1. Introduce the activity and select a volunteer that is willing to tell the class all of the foods that were consumed on the day of the activity.

2. List these foods and beverages on the board and then ask the class whether this student is getting all of the nutrients that are required for good health.

3. How can we determine if this student is getting all of the necessary nutrients? Elicit student responses and list them on the board.

Development:

1. Introduce and distribute the USRDA nutrient tables and the calorie lists.
   a. Why do the tables say that we require so many calories when people who diet try to eliminate as many calories as possible from the diet?

Elicit that the calorie is a measure of the energy contained in food. Present the students with the definition of the food calorie (kilocalorie) and use the food list on the blackboard to demonstrate how the list can be used to determine a person's total daily caloric intake.

b. Repeat the demonstration for carbohydrate, protein, calcium and other selected nutrients. As some of the students might be interested in the quantities of specific nutrients such as salt (sodium), the teacher might elicit student input in determining the actual nutrients that should be examined during this activity. The teacher should demonstrate how nutrition information on various foods can be obtained by reading the nutrition labeling on food packages.

2. At this point inform the students that they will use the computers and a spreadsheet program to learn how to evaluate their own diets.

3. Distribute the software and the DOS disks. If the students are not familiar with the operation of the computers, inform them that they should not bend or fold the disks and should not place anything but the diskettes into the disk drive.

4. Instruct the students to insert the DOS disk (if required) into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. When they get the date/time prompts tell them to strike the space bar. When they get the "A" prompt, instruct them to remove the diskettes and insert the program disk. They should follow the instructions that accompany the program to load and prepare the spreadsheet for use.

5. Instruct the students how to enter titles or labels and set up the spreadsheet program. As an alternative, the teacher may set up the spreadsheets prior to the class period. Instruct the students in the techniques in the techniques necessary for the entry of data and titles, and the techniques and format for the entry of formulae.

6. Allow the students to have an opportunity to enter all of the foods consumed, the portion size, and the quantities of the calories and nutrients contained. The students should be informed that all of these nutrient quantities may be inaccurate. The students should be aware that this activity is being performed as a learning activity and they should speak with their doctor or a nutritionist if they have specific questions about their individual diets.

7. This activity may require more than one class period to complete. The students should be made aware that they can save their spreadsheet data on a disk and continue to work with the data at another time.

8. The students should be presented with the opportunity to print out a paper copy of the spreadsheet. This can be used to answer questions and for comparison with the nutrition spreadsheets prepared by other students?

9. At the conclusion of the computer activity, instruct the students to place the diskettes back into their protective envelopes, close the disk

drive doors and turn off the computers and monitors. WARNING: BE SURE THAT THE SPREADSHEET HAS BEEN SAVED ONTO A DISK BEFORE THE MACHINE IS TURNED OFF. REMIND THE STUDENTS THAT IF THE DATA IS NOT SAVED IT WILL BE LOST! It may be desirable for the teacher to have each student also make a backup disk or perform multiple saves on the same disk.

Summary:

1. Do all people of the same age and sex require the same number of calories per day?
2. What happens to the body if we consume an excess number of calories? What about a shortage of calories?
3. How much protein is required by a person of your age and sex each day? What happens to the excess protein that you consume? Why must you consume protein daily to maintain good health?
4. Did you discover a shortage or deficiency in any of the nutrients that were studied in class? How can you improve your diet?

Homework: Use your biology textbook to help you complete this assignment.

1. What are the functions of vitamins and minerals in the human diet?
2. How are carbohydrates used within the human body?
3. What are the eight essential proteins? Why are these considered to be "essential" while the other protein molecules are not.
4. Based upon the analysis conducted in class, how would you improve your own individual diet?

Enrichment:

Investigate the diets of the Eskimos and the Masai people. Do they obtain their required nutrients with their specialized diets?

TOPIC 54
The Human Circulatory System

Aim: How does blood circulate through our bodies?

Performance Objectives: Student will be able to:

- understand that blood flows in most animals in a closed system of blood vessels
- understand that the circulating blood provides a transport system for the body
- list and identify the components (parts) of the system including arteries, veins, capillaries, the heart, and the blood itself, a liquid tissue
- compare the functions of the arteries and veins in addition to visualizing the role of capillaries.

Materials:

- MS-DOS based microcomputer laboratory (IBM, Tandy)
- computer software: Human Circulatory System by Educational Materials and Equipment Company
- worksheet: "The Circulatory System" for labeling
- record keeping material to chart student scores on computerized quizzes and test

Do Now:

Define the following terms and use them in sentences:

1. circulate
2. transport
3. tissue
4. nutrients

Motivation: Place the following on the board or ask aloud:

"What does the New York City subway system have in common with the human body?"
In the subway people travel in a way that is similar to the way that blood travels throughout the body. Both are transport systems.

Development:

1. Continue the analogy by asking: "How is the subway system in New York organized?"
   The subway system has various lines and routes which run trains through concrete tubes underneath the surface of the city. The trains deliver people to points along all of the routes. Later the train system takes the people back to where they started from.

2. Ask: "How is this system of tubes similar to structures within the human body?"
   The human body has a transport system of its own. The circulatory system carries blood around the body so that the blood tissue can deliver oxygen and nutrients to the cells and pick up wastes before it is moved away from the site.

The tubes in the Circulatory System are:
arteries - which carry blood away from the heart
veins - which carry blood to the heart
capillaries - a network of tiny tubes which connect arteries and veins throughout the body.

Introduce students to the aorta, vena cava, pulmonary arteries and pulmonary veins. Discuss the direction of circulation and the color of the blood on each vessel.

3. Explain that the microcomputer can be programmed to demonstrate activities or present ideas and concepts that are too costly or dangerous to be presented in real life. This kind of electronic substitution is called a simulation. That is, a program will simulate the real event. The computerized event is now under the complete control of the user. Examples of this are the astronaut spacecraft training simulations and the flight simulators used to train pilots.

4. Provide the student with a microcomputer and the computer software "Human Circulatory System". Load the software and follow the instructions on the screen. Have each student proceed through the tutorial frames at an independent pace. Direct the students to take notes on the content of the reading passages attached to the different graphics. Less mature students should be provided with a series of guide questions to assist in note-taking and to direct attention to key facts and concepts.

5. Instruct the student to STOP (press the "S" key) when the (9th) "Complete Circulation" frame appears. It shows the gross structure and movement of the blood, with sound, around the circulatory system.

6. Distribute the worksheet (similar to the readout). Encourage the class to place an arrow with the name of each significant part in the proper place.

7. Point out that there are two kinds of circulation being described in the graphic. One called, pulmonary circulation is the system which transports blood to be oxygenated in the lungs. The other, systemic circulation circulates blood to the other parts of the body where the blood delivers nutrients and oxygen and picks up wastes from the cells. In both kinds of circulation the blood leaves the heart and comes back to the heart through a closed system of tubes. Reiterate the functions of the arteries and veins. Write the following mnemonic device on the board:

   Arteries Away, Veins the other way!

8. Continue the simulation by touching the "C" key.

   Do not permit students to advance beyond the simulation since a surprise quiz is going to appear.

   In order to be effective, it is suggested that students be encouraged to observe the simulation for a protracted period of time.

9. Notes are to be taken regarding structures and events appearing on the screen. Relative positions are to be noticed and generalizations are to be encouraged.

10. Permit each student to advance to the next frame. A surprise multiple choice quiz will appear. Each student will be quizzed and graded.

    If the student gets all of the questions correct, suggest that further reading for independent study is appropriate. Provide standard materials. Encourage a review of the program or assign to a peer as a tutor.

    If the student is not successful, suggest a review of the material and another quiz. If mastery is not achieved at this point, have available slower-paced study sheets covering the same content, but focusing on one aspect at a time. Assign a peer tutor to a student if necessary.

Summary:

1. What is circulation?
2. What is blood?
3. Where does the circulation of blood take place in human beings?
4. What is the difference between an open and a closed system? Name one example of each.
5. What are the major parts of the circulatory system?
6. What are the three kinds of blood vessels?
7. Describe the flow of blood in arteries and veins.
8. How does the flow of blood to the lungs flow of blood in arteries to other body organs?

Homework:

1. Study and learn each detail of the diagram describing the gross anatomy of the circulatory system.

2. List the major components of the circulatory system.

3. Describe and compare the functions of each.

Enrichment:

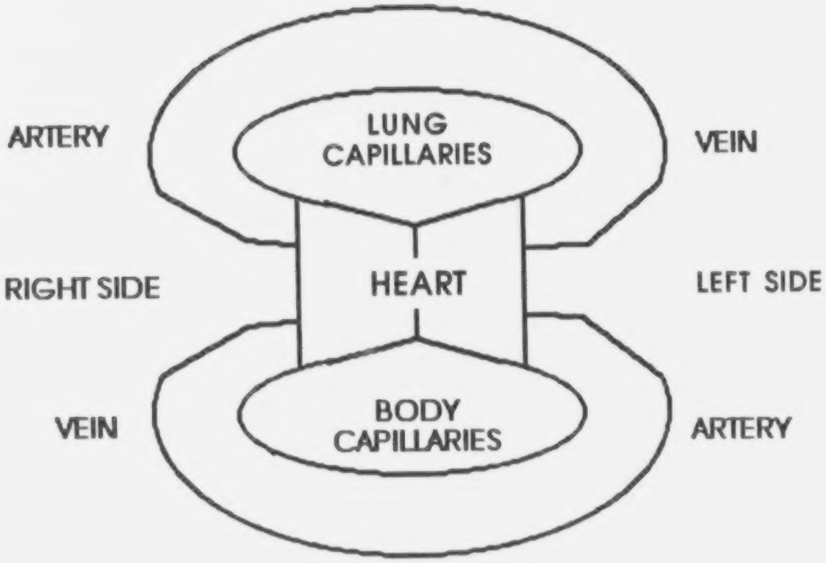
1. Write a paragraph describing the functioning of the circulatory system as it applies to the lungs. Why do humans have pulmonary circulation as well as regular circulation?

2. Write a report on the functions of the blood.

3. Explain capillaries, capillarity, and the functions of capillaries in the body.

4. Diagram the flow of blood through the circulatory system.

5. Research and report on the various medical specialists and technicians associated with the study of blood and the circulatory system.


LUNG CAPILLARIES
ARTERY
VEIN
RIGHT SIDE
HEART
LEFT SIDE
VEIN
BODY CAPILLARIES
ARTERY

TOPIC 55
The Human Heart

Aim: What is the structure of the heart?

Performance Objectives: The student will be able to:

- define the function of the human heart
- list the four chambers of the heart
- identify the major blood vessels attached to the heart and explain their destinations

Materials:

- MS-DOS based microcomputer laboratory (IBM/Tandy)
- software: Human Circulatory System by Educational Materials and Equipment Company
- worksheet: "The Structure of the Human Heart"
- record keeping material to chart student scores on computerized tests and quizzes.

Do Now:

Define or describe: artery, vein, capillary, systemic circulation, pulmonary circulation.

Motivation:

Display a model of the heart or a large chart. How is the heart constructed so that it can perform both systemic and pulmonary circulation?

Development:

1. Ask: What is the structure of the human heart?

   The human heart is a four-chambered muscular pump. It is connected to the body through sets of blood vessels known as arteries, veins and capillaries. It is the major organ of the circulatory system. It pumps blood, in a closed system. The circulating blood is responsible for the transportation of nutrients, oxygen, carbon dioxide and cellular wastes.

2. Ask: What is the function of the heart?

   The function of the heart is to pump. In humans, the blood remains in the blood vessels.

3. Ask: How can we understand the role of the heart?

   The heart and the circulatory system are complex. In medicine, cardiologists are specialists, doctors who concentrate on problems of the heart and the circulatory system. Circulation is a dynamic process. We need to see it in motion as well as on paper to understand it.

5. Provide the students with microcomputers and the program "Human Circulatory System". Have the students boot up the program and begin the tutorial. Have the students read or review the work covered in section

1 and then take the quiz. Record the grade. Time does not permit another review at this point. Have the student advance to section 2 (The Four Parts of the Heart Diagram).

6. How does the heart perform the task of sending blood to the body and the lungs?

   This task is accomplished by a four-chambered heart located in the center of the chest. During each beat (a contraction) the chambers expand and contract creating pressure and suction on the liquid blood. The alternating pressure and suction causes the movement of the blood throughout the system. Valves prevent the backward flow of blood in the wrong direction.

7. Distribute the worksheet. The students will copy and label the diagram of the heart. Have the student read the text.

8. The students will advance one frame and copy and label the diagram of the right side of the heart and the vessels associated with it. Have the students read the text. Provide guide questions for notetaking and vocabulary assists for unfamiliar words.

9. The students will advance one frame and copy and label the diagram of the left side of the heart and the vessels associated with it. Have the students read the text.

10. The students will advance until the second animated graphic of the program appear. It shows the movement of blood through the body and the general pathway of the circulatory system. The students should be encouraged to observe this simulation for a sufficient period of time for full comprehension. Have the students STOP the program (S) in order to copy and label the diagrams and the worksheet. Have the students finish the worksheet.

11. Continue the program (C) until the students are presented with a surprise quiz. Record the score.

    If a student gets all of the questions correct, suggest that further reading for independent study is appropriate. Provide standard materials. Encourage a review of the program or assign to a peer as a tutor. Request that he/she compose challenge quizzes (true-false, crossword puzzle) for classmates.

    If the student does not get all of the questions correct suggest a review of the material and another quiz. If mastery is not achieved at that point, other methods are indicated, including assignment to a peer tutor provided with slower-paced study sheets.

Summary:

1. What is the human heart?
2. What is the major function of the heart?
3. What are the four chambers of the heart?
4. What are the major vessels that are attached to the heart? What is the function of each?

5. What is a contraction? How does the heart cause the pressure and suction which moves blood through the blood vessels?

Homework:

1. Answer the following questions.
    a. What is the aorta?
    b. Where does the vena cava join the heart?
    c. What causes the blood pressure in arteries?
    d. What is the purpose of both atria of the heart?
    e. What is the purpose of both ventricles?
    f. What is the function of the heart valves?

2. Make a large chart suitable for classroom display that shows the major parts of the heart, the major blood vessels, flow, the oxygen content of the blood, etc.

Enrichment:

1. Explain the possible consequences of various malfunctions of the heart.

2. Research and report on diseases of the heart. Be prepared to show sources of information. Compare the information found to other significant health problems.

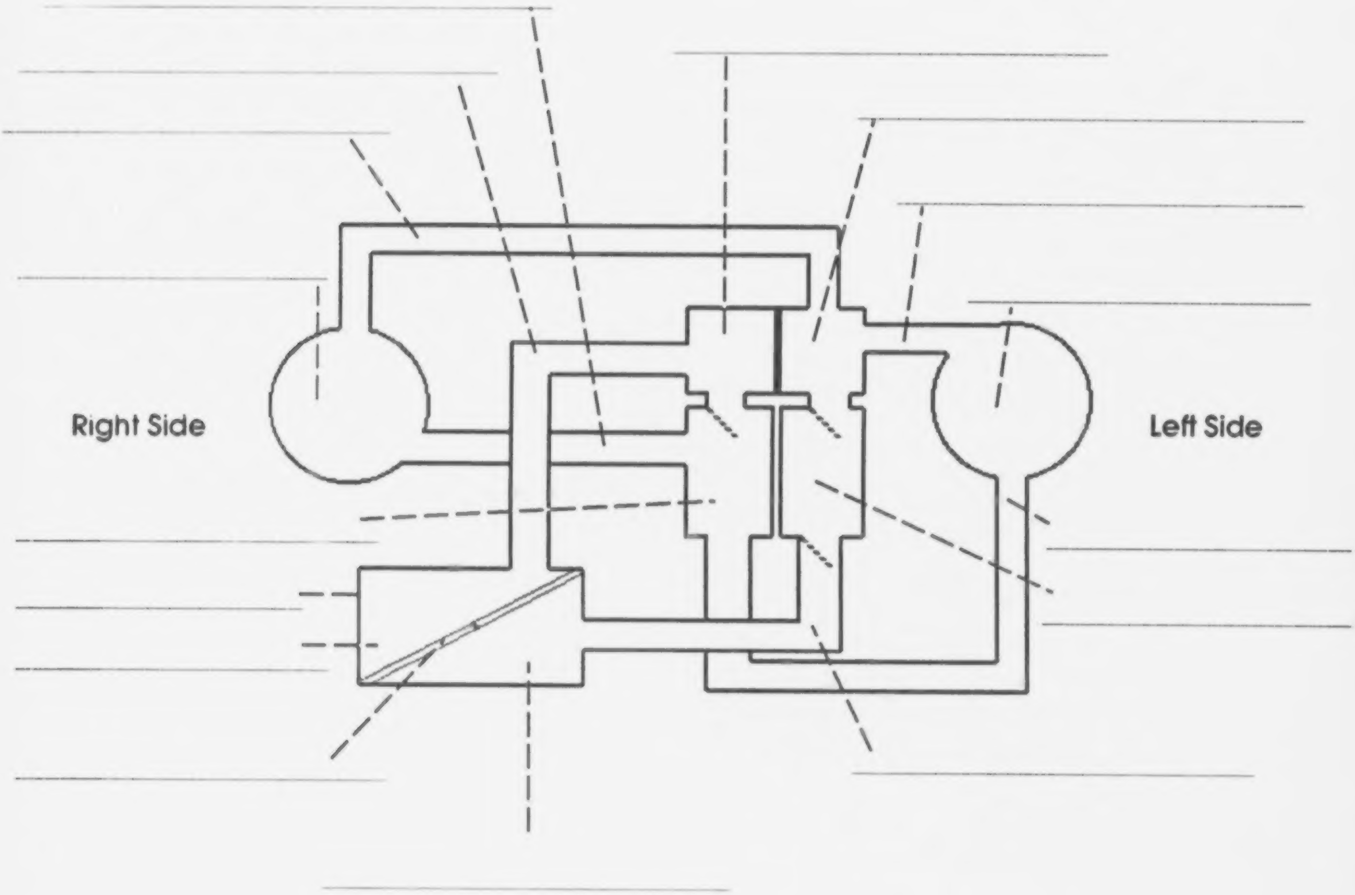
3. Research and report on the latest medical technology available to monitor and improve the health and quality of life of persons with heart disease.

4. Take the pulse rates of 10 different people at rest and again, immediately after two minutes of vigorous movements. Chart the data and determine any patterns. Repeat the procedure one hour later.

5. Describe the method used to measure blood pressure. Why must a person's blood have pressure? What factors cause changes in a person's blood pressure?

WORKSHEET — The Human Heart

Name ____________________ Class ____________ Date________


Right Side
Left Side

TOPIC 56
Respiration and the Human Circulatory System

Aim: How do the lungs interact with the circulatory system?

Performance Objectives: The students will be able to:

- describe the function of hemoglobin
- understand the function of the lungs, alveoli and capillary network within the lungs
- describe the function of respiration as an exchange of carbon dioxide for oxygen in the alveoli
- visualize the function of heart valves
- explain how a complete system in the body (blood vessels, etc.) functions to maintain a life function
- describe oxidation

Materials:

- MS-DOS based microcomputer laboratory (IBM/Tandy)
- software: Human Circulatory System by Educational Materials and Equipment Company
- worksheet: "Flowchart for the Blood..."
- record keeping material to chart student scores on computerized tests and quizzes.
- samples of steel wool and rusted steel wool

Do Now:

Explain the function of each of the following in the circulatory system: Right Atrium, Right Ventricle, Left Atrium, Left Ventricle

Motivation:

Ask: "What is rust? What causes it?"

The desired answer, after discussion, is "the reddish-brown compound that is formed when oxygen combines with iron."

Display the pieces of steel wool and rusted steel wool. Tell the class that iron oxide is produced by the oxidation of the metal but that the process is reversible. The oxygen can be removed by reduction.

Development:

1. Ask "When iron combines with oxygen, how does the metal change?" The color change is dramatic. Also, it loses its strength and becomes crumbly.

2. Ask "Does this chemical reaction ever take place in human being? Is there anything like iron in our bodies that combines easily with oxygen? Yes. It is a substance known as hemoglobin, an iron compound that is found in the red blood cells of humans.

3. Ask "How does hemoglobin work in humans?

   When deoxygenated blood is delivered to the lungs it comes into contact with air in the alveoli of the lungs. The alveoli, which are the microscopic air sacs of the respiratory system, are covered with a moist membrane and a very fine network of capillaries that carry red blood cells.

   During circulation through the lungs, the hemoglobin absorbs oxygen to become oxyhemoglobin, while at the same time, carbon dioxide gas is released from the blood. Hemoglobin changes color when exposed to oxygen. Deoxygenated blood is dark red and oxygenated blood is bright red. Explain that in illustrations blue is sometimes used to represent deoxygenated blood. Blood is never really blue.

   The "new" oxyhemoglobin in the red blood cells is moved by the circulatory system through its pulmonary veins to the heart and then to the organs and capillary networks of the body. The attached oxygen can then be delivered. Veins return the deoxygenated blood.

4. How can we use technology to learn about the role of the lungs in human circulation?

   Provide the student with a microcomputer and the computer software "Human Circulatory System". Load the software and follow the instructions on the screen. Have each student proceed through the tutorial frames at an independent pace. Direct the students to take notes on the content of the reading passages attached to the different graphics.

5. The student will run the program until the third animated graphic of the entire circulatory system is presented. Instruct the students to study the simulation for a protracted period of time to insure comprehension. Notes and diagrams should be encouraged. The students should STOP (S key) the simulation in order to signal the teacher.

6. Distribute the Flowchart. Have the students identify the steps in the circulation process. Discuss.

7. The discussion should focus on the flowchart and the observable events that take place during the third simulation. It is recommended that the following points, among others be highlighted during the simulation and during the follow-up discussion.

   . How is oxygenated blood represented? (Red)
   . Where is it found? (Arteries)
   . What is the exception to this? (Pulmonary Artery)
   . Why is deoxygenated blood found in an artery?
   . How is deoxygenated blood shown? (Blue)
   . Where is it usually found? (Veins)
   . What is the exception to this? (Pulmonary Veins)
   . Why would oxygenated blood be found in the pulmonary veins? (Veins move blood back to the heart, and in this case, refreshed blood is returning to the heart to be circulated.)

- What would happen during a contraction of the heart (a beat) if the heart valves were not functioning? (The blood would be pushed backwards.).
- What is the role of the valves? (They open and close in response to the contractions of the chambers that they are separating.)
- What took place in the lungs? (Exchange of gases.)
- Where does the oxygenated blood go immediately after the lungs? (Pulmonary vein into the left atrium.)
- What are the names of the two body systems that interact to provide oxygenated blood to the body cells? (Circulatory and Respiratory)

8. Have the student CONTINUE (C Key) with the test that will follow the simulation. Record the score.

9. If time permits, allow the student to run the entire program again. Be prepared to record student scores on two intermittent quizzes and a test. Compare the new scores with earlier attempts.

Summary:

1. What is oxidation?
2. Where does the blood carry oxygen?
3. Where does oxygen enter the blood?
4. Why must oxygen be delivered to the cells?
5. How are wastes removed from the cells?
6. What is the network of blood vessels that surrounds the alveoli of the lungs?
7. Why does the blood change color when exposed to oxygen?

Homework:

1. Explain the role that the valves of the heart play in the movement of blood in the body.

2. What is a stethoscope? Why would the human heartbeat make two distinct noises, often pronounced "LUB-DUB"? Explain a heart murmur.

3. Which are the only arteries that carry deoxygenated blood? Explain. Which are the only veins that carry oxygenated blood? Explain.

4. What is the iron compound in the blood? Why is it important and where is it found in the blood?

5. Compare and contrast the capillary network in the lungs with the capillary networks found throughout the other organ systems.

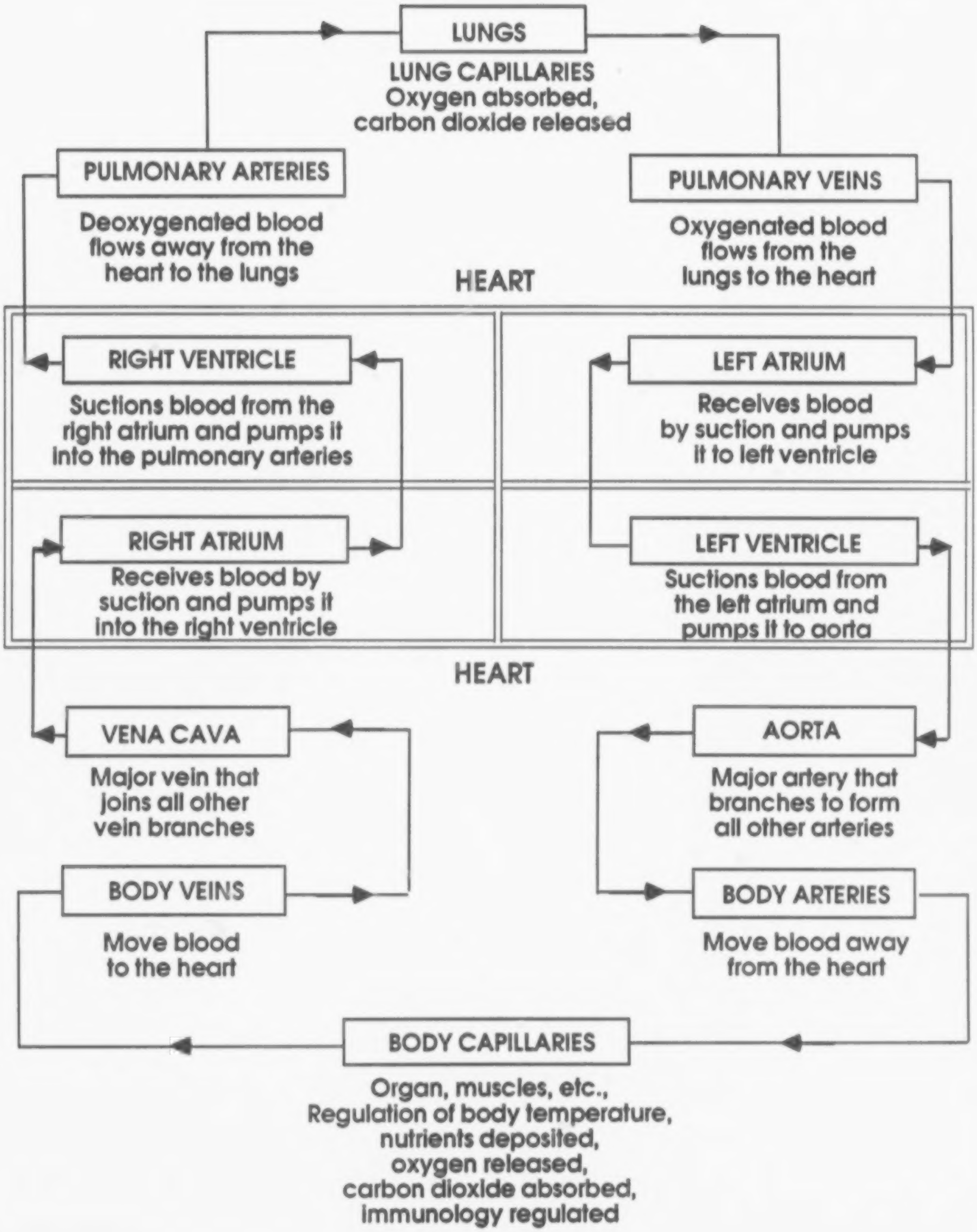
6. List and describe the major components of the respiratory system.

Enrichment:

1. Write a report on the use of computerized heart monitors.

2. What is anemia? How does it affect the body? Research and write a report on sickle cell and other kinds of anemia.

Flow Chart for Blood in
the Circulatory System


LUNGS
LUNG CAPILLARIES
Oxygen absorbed,
carbon dioxide released
PULMONARY ARTERIES
Deoxygenated blood flows away from the heart to the lungs
PULMONARY VEINS
Oxygenated blood flows from the lungs to the heart
HEART
RIGHT VENTRICLE
Suctions blood from the right atrium and pumps it into the pulmonary arteries
LEFT ATRIUM
Receives blood by suction and pumps it to left ventricle
RIGHT ATRIUM
Receives blood by suction and pumps it into the right ventricle
LEFT VENTRICLE
Suctions blood from the left atrium and pumps it to aorta
HEART
VENA CAVA
Major vein that joins all other vein branches
AORTA
Major artery that branches to form all other arteries
BODY VEINS
Move blood to the heart
BODY ARTERIES
Move blood away from the heart
BODY CAPILLARIES
Organ, muscles, etc.,
Regulation of body temperature,
nutrients deposited,
oxygen released,
carbon dioxide absorbed,
immunology regulated

3. What are the functions of human blood? How does the circulatory system perform these functions? Be sure to give examples of each function and identify the relevant parts of the body.

4. Research and write a report on unhealthful practices by young people that may cause damage to the respiratory and/or circulatory sytems, e.g. smoking, sniffing glue, using drugs that are inhaled.

TOPIC 57
The Pulse

Aim: What does the pulse tell us about the functioning of our circulatory systems?

Performance Objectives: The students will be able to:

- count a person's pulse using the radial artery or the carotid artery
- explain what factors can cause variations in the pulse rate
- calculate an average using data obtained from the lesson
- explain how the pulse can be used as a measurement of physical fitness
- plot a line graph showing the changes that have occurred in the pulse

Materials:

- MS-DOS computer labs
- software: any spreadsheet program and DOS if required
- a large clock with a sweep second hand
- stethoscopes and alcohol swabs
- graph paper or a graphing program that can be used with student derived data
- printers attached to one or more of the computers (optional)

Do Now:

List and explain the major components of the circulatory system. List the substances which are transported by the blood.

Motivation:

1. The teacher should seek two volunteers, one student that is sedentary and does not exercise regularly, and another student that is active in sports or exercises aerobically at least four times per week. The two students should be asked to come up to the front of the room and remain quietly seated. This will permit their pulse rates to drop to the resting level.

2. The teacher should then select two additional student volunteers to serve as pulse takers.

3. The two students should take the pulse of the two students that are seated. The data should be recorded on the chalkboard

4. The two subjects should be instructed to exercise vigorously for a period of one minute. They should run in place or do calisthenics. Immediately after the exercise their pulse rates should be measured again and recorded on the board.

5. Two minutes after completion of the exercise the pulse should be taken a third time. This data should also be recorded.

6. How did the pulse rates differ? What factors may have contributed to the differences observed in the two students.

Development:

1. The teacher should list possible explanations for the observed differences in the two students' pulse rates. In general, a person that engages in aerobic exercise on a regular basis should have a slower resting pulse rate than a person of the same age and sex that is sedentary or does not exercise regularly. THIS HAS BEEN PROVIDED TO ASSIST THE TEACHER AND SHOULD NOT BE EXPLAINED TO THE STUDENTS AT THIS TIME.

2. The teacher should assist the students in forming groups for this activity. The students should be grouped according to sex and sports or fitness activities. Some possible groups could be: males that exercise, females that exercise, males - sedentary, females - sedentary, males that smoke, females that smoke, etc. If there are many student athletes in the class it may be desirable to form separate groups for football players, weight lifters, etc...

3. The students should be seated in their activity groups and instructed that they should sit quietly if they want the results of the experiment to be accurate. While they are resting, the teacher should introduce the stethoscope and explain how it can be used to listen to the heart. The teacher should warn the students of the danger involved in shouting or blowing into the stethoscope bell (damaged eardrums!) and should demonstrate how the ear tips should be cleansed with alcohol before the ear tips are placed in the ears.

4. Have the students first count their heartbeats for one minute using the stethoscopes and then count their resting pulse rates for one minute. Both of these numbers should be recorded on the worksheet. The students should work in pairs.

5. Have the students exercise and then record their post exercise pulse rates. WARN THE STUDENTS THAT THEY SHOULD NOT PARTICIPATE IN THIS ACTIVITY IF THEY ARE MEDICALLY EXCUSED FROM GYM.

6. In addition, the students should also take the recovery pulse rate two minutes after completion of the activity.

7. At the conclusion of the pulse rate activity inform the students that they will use the computers and a spreadsheet program to calculate the pulse rate averages and see if any trends or patterns can be observed.

8. Distribute the software and the DOS disks (if necessary). If the students are not familiar with the operation of the computers inform them that they should not bend or fold the disks and should not place anything but the diskettes into the disk drive.

9. Instruct the students to insert the disk into the drive and follow the instructions that accompany the spreadsheet program. The students should be working with their experiment groups and should enter the data for the entire group. The students should also enter the formulae necessary to compute the averages. They should perform the calculations using the spreadsheets and also save the completed spreadsheet onto a blank formatted disk.

Conclusion:

At the completion of this activity the teacher should ask specific groups for the averages that they have calculated and should put this information on the board. The class should discuss the results and see if any discernible differences have occurred. In general, the following patterns should emerge.

a) Females have resting pulse rates that are faster than males.
b) Students that engage in aerobic activity have slower pulse rates than sedentary students.
c) Students that engage in isotonic exercise or weightlifting have faster pulse rates than those that engage in aerobic exercise.
d) Smokers have faster pulse rates than non-smokers. This would be more apparent in adults that have smoked for many years.
e) People that are overweight often have faster pulse rates than people that are of normal weight.

Homework: Use your biology textbook to help you complete this assignment.

1. Count your own pulse when you first wake up in the morning, before you get out of bed. Continue to take your pulse at two-hour intervals throughout the day. Keep a written record of each pulse rate, the time of day when the measurement was made, and the activity that you performed prior to taking your pulse.

2. Plot a line graph showing the changes that occurred in your pulse rate during the day of your study.

3. What factors caused your heart rate to increase, decrease. Use your biology textbook to determine the reasons why these changes may have occurred and write a short report on the way that the heart and blood vessels react to outside stimuli and internal conditions in order to help maintain homeostasis.

4. What may be the significance of:
   a. an unusually high resting pulse rate
   b. a slow recovery time of pulse rate following vigorous physical activity

WORKSHEET — The Pulse

Name ______________________ **Class** ________ **Date** ________

Class _____________
Date _____________

Check the appropriate boxes:

☐ male

☐ female

Group # _______

Activity Rating

☐ aerobic exercise ☐ calisthenics/weights ☐ football team

☐ smoker ☐ non-smoker

Describe the sounds you heard listening to the heart with the stethoscope. What do you think causes these sounds? ______________________________

____
____
____
____

Resting heart rate trial #1 _____ trial #2 _____

Resting pulse rate trial #1 _____ trial #2 _____

Exercise - Follow directions given in the class. To get accurate measurements exercise as hard as you can.

pulse rate immediately after exercise _______________

pulse recovery rate _______________

Do not participate in this exercise if you are medically excused from gym.

WARNINGS: Do not blow or yell into the stethoscope. You can injure your eardrums. Clean the ear tips before using the stethoscope. Remain quiet to permit everyone to hear the quiet sounds.

* Exercise activity before the testing measurements will prevent you from getting accurate data about your heart.

TOPIC 58
Factors Influencing Heartbeat Rates

Aim: What factors influence our heartbeat rates?

Performance Objectives: Students will be able to:

- design and conduct experiments measuring the rate of the heartbeat using a microcomputer for data aquisition and recording
- explain how pulse rate measurements can be made using a light probe and microcomputer
- explain what factors cause changes in the heart rate in healthy people

Materials:

- Apple computer with large display monitor or Apple computer lab
- Apple DOS 3.3
- laboratory hardware - HRM MICRO/scope box and probes, connecting wires
- software: Experiments in Human Physiology by HRM software
- rexographed lab sheets
- rubbing alcohol (70% alcohol) and cotton swabs
- watch with sweep second hand
- masking tape or adhesive tape
- a milk crate or other platform approximately 12 inches tall

NOTE: The hardware should be connected to each computer prior to the start of this lab activity. Instructions are included within the software documentation. See page 39 for instructions on setting up the hardware.

Do Now:

Count your pulse for one minute and record the number. Obtain the data from the students surrounding you and calculate the average pulse rate for your lab group.

Why is it a good idea to understand the expected values for a series of measurements prior to conducting the actual experiments?

Motivation:

Display a single Apple computer equipped with the HRM MICRO/scope box and hardware for heart rate measurement. Load the software "Experiments in Human Physiology." Display the heart rate sensor and explain to the students how the computer can be used to measure the heart rate by measuring the variations in the amount of light that passes through the skin with each pulse. Select a student volunteer and demonstrate the measurement of heart rate using the computer. Hold the tip of the sensor probe against the fleshy part of the finger tip. IT MAY BE NECESSARY TO TRY DIFFERENT FINGERS AND DIFFERENT POSITIONS ON THE FINGERTIP TO GET ACCURATE MEASUREMENTS. To start the measurement process, select #3 "Heart Rate Measurement" from the main menu. Press "S" (start) and RETURN to start recording data.

The Heart Rate experiments can be performed as a laboratory activity with the students working in groups or can be performed as demonstration activities using a single computer and several volunteers.

Development:

1. Ask the students to suggest one or more experiments that can be performed using the computer to monitor and record heart rates. Suggested activities for experimentation include exercise, biofeedback, exposure to an experimental stress, consumption of caffeine (coffee), etc. List these experiments on the board and discuss the procedures that could be used to perform each of the experiments. Challenge the students to develop practical applications for the monitoring and recording of heart rates through the use of electronic devices.

2. Distribute the laboratory worksheet and explain to the students that they will perform experiments to determine the effects of various external stresses on the heart rate.

3. Select a volunteer subject and instruct the subject to sit quietly for several minutes. Wash the probe with alcohol and attach it to the student's fingertip using the tape so that the computer displays a regular pulse rate. IT MAY BE NECESSARY TO TRY SEVERAL POSITIONS BEFORE OBTAINING ACCURATE READINGS. DATA MAY ALSO BE RECORDED WITH THE PROBE ATTACHED TO THE EARLOBE.

4. Record the heart beat rate while the student is sitting and resting. Instruct the student to breathe naturally while the measurements are being taken. The data should be recorded for two to three minutes. Instruct the subject to breathe rapidly and deeply. What changes were observed in the heart rate? Why? Allow the pulse rate to recover and instruct the student to stop breathing for as long as possible. Record the heart beat during the period of breath holding and throughout the recovery period.

5. Select another volunteer and record the resting heart rate. Instruct the student to stand up and perform the step test exercise. Stepping up onto the box and then stepping down off the box at a rapid rate for two minutes. Continue to record data during this time period. At the conclusion of the exercise instruct the subject to sit down and continue to record data until the pulse rate stabilizes. Do not permit a student who is medically excused from gym to serve as the subject of this experiment.

6. If time permits the class can conduct other experiments. Use the initial list of student suggestions. Good results can be obtained by having a subject drink a cup of strong black coffee or smoke a cigarette while recording data. External stimuli such as unexpected loud noises or the immersion of the free hand in a basin of ice water also yield observable results. The immersion of a hand into ice water shows how the heart rate responds to pain.

7. At the conclusion of the computer activity, instruct the students to disconnect the probes and wash them with alcohol and place the diskettes back into their protective envelopes, close the disk drive doors and shut off the machines.

Summary:

1. What factors cause changes in the heart rate of a healthy person? Why?

2. What is the range of the pulse rate that should be found in a healthy teenager? Why is the measurement of the pulse rate used as a tool for diagnosing illness?

3. Can conscious control influence the heart rate? How does the heart rate respond to activity, psychological and physiological conditions, foods and drugs?

4. What variations would you expect to find if you can monitor a person's heart rate for a 24-hour period?

Homework: Use your biology textbook to help you complete this assignment.

1. Describe the mechanisms that regulate or control the rate of the heartbeat in humans.

2. What is the relationship between physical condition and pulse rate?

Enrichment:

1. Develop an experiment to show how the foods we consume can cause changes in the pulse rate. Perform the experiment and report the results to the class.

2. Psychological stress can cause changes in the pulse rate. How are measurements of these changes used in lie detection equipment (polygraphs)?

DATA SHEET — Factors Influencing Heart Rate

Date ____________ **Subject** ______________ **Observer** _____________

Effect of experimental variable on the heart rate

1. Variable to be tested __________________________

2. Resting heart rate (take three readings at one-minute intervals and calculate the average) _________________ beats/min.

3. Stimulus period:
Time when stimulus or activity was begun ___________________

Time when stimulus or activity was stopped _________________

heart rate observations

1. ___________ beats/min.

2. ___________

3. ___________

Describe the changes in heart rate that were observed.

4. Recovery period

1. heart rate immediately following end of stimulus or activity

___________ beats per minute Elapsed time ___________

2. ___________ beats per minute Elapsed time ___________

3. ___________ beats per minute Elapsed time ___________

4. ___________ beats per minute Final heart rate _______

What was the length of time required for the heart rate to return to the pre-experimental level? _______________________________

TOPIC 59
The Pulse in Relation to Physical Fitness

Aim: What does the pulse tell us about our level of physical fitness?

Performance Objectives: The students will be able to:

- analyze numerical data that resulted from a laboratory activity
- develop hypotheses based upon data
- learn how to use the pulse to monitor their individual levels of fitness
- identify exercise regimens that are good for cardiovascular conditioning
- explain what happens to the heart and blood vessels as a result of conditioning

Materials:

- MS-DOS computer labs
- software: a spreadsheet program, DOS (if required)
- teacher prepared data disks containing selected groups of student data from the previous lesson
- graph paper and a straight edge or ruler
- an overhead projector and previously prepared graphs showing the cardiovascular response to exercise of both a trained and an untrained individual.

Do Now:

How does the heart of an athletic person compare with that of a non-athlete?

Motivation:

1. Project the two graphs onto a screen. Ask the students: What differences do you observe in the two graphs curves?

2. What factors might have contributed to the differences in cardiovascular response between the two students?

3. List the student responses on the chalkboard and explain to the students that they will use the computers to analyze the results of yesterday's lab and see how the pulse can be used as a method of monitoring a person's level of fitness.

Development:

1. If any of the students are not familiar with the operation of the spreadsheet software or the operation of the computers, tell them not to bend or fold the disks and not to place anything but the diskettes into the disk drive.

2. Instruct the students to insert the spreadsheet program disk into drive "A", close the door and load the program. The students should then place the data disk in the drive and load the data. The procedure will vary, based upon the spreadsheet that is being utilized.

3. Instruct the students to call up specific data tables for comparison. Instruct the students to call up the data that has been collected for the sedentary students and the aerobics groups.

4. Place the following questions on the board and instruct the students to answer them using the data from the spreadsheet and their knowledge of the circulatory system.

   a. Why do people who are engaged in aerobic training generally have slower pulse rates?
   b. What do you think happens to the heart and blood vessels as a result of regular aerobic exercise?
   c. The stroke volume is a measurement of the quantity of blood pumped with each heartbeat. How would the stroke volume of a trained athlete compare with the stroke volume of a sedentary person when both people are at rest?
   d. How does the recovery pulse of the aerobically trained students compare with the recovery rates of the sedentary students? Why do you think a difference occurs?
   e. Why do people who participate in aerobic exercise reduce the chance that they will suffer from heart attacks?
   f. If you were to start participating in aerobic exercise, what techniques could you use to monitor your progress in becoming physically fit?
   g. How did the pulse rates of the weightlifters and football players compare with the pulse rates of both the sedentary students and the aerobics students? Does the data indicate that there is a relationship between large, strong muscles and cardiovascular fitness?
   h. Is there a difference in the pulse and heartbeat rates of the males and females within the class? What factors may contribute to this difference

5. At the conclusion of the computer activity, instruct the students to place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers and monitors.

Summary:

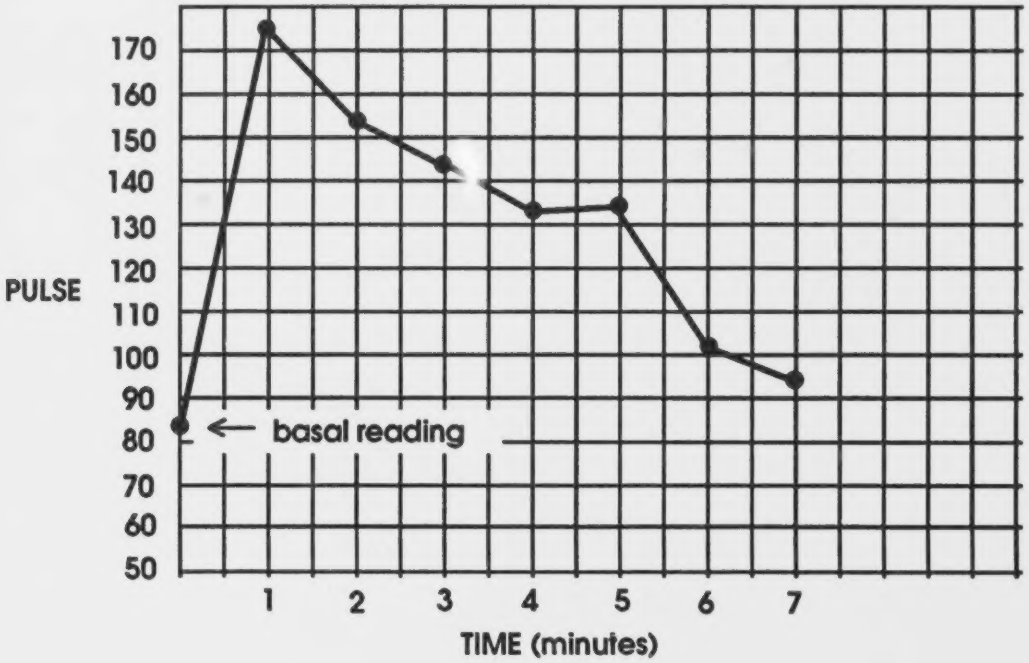
1. Call upon students to read their responses to the questions and list the salient points of the student responses on the board.

2. The students should be aware that aerobic training increases both the ability of the heart to pump blood, and the stroke volume or quantity of blood pumped with each beat. For this reason the heart can beat slower and still pump the same quantity of blood.

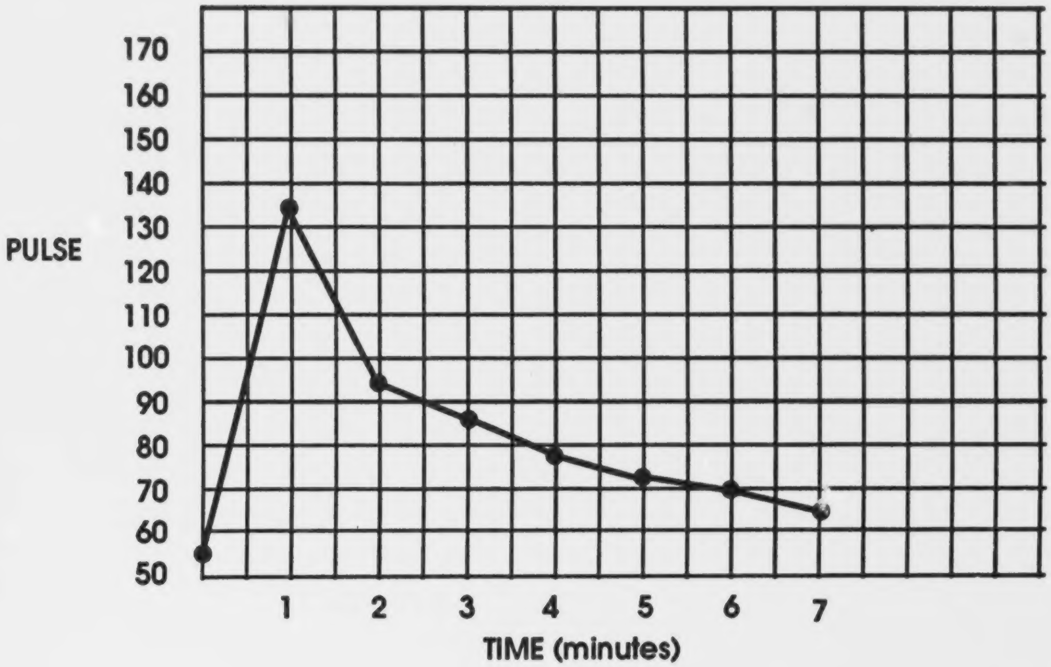
3. Elicit from the students that as a person's level of cardiovascular fitness improves, the heartbeat slows. Therefore by monitoring the resting pulse, you can tell if you are improving your level of fitness. Then, discuss the best technique for such monitoring. As the pulse rate is constantly changing as a result of activity, internal conditions and emotions, the best time to count your pulse for the purpose of fitness monitoring is immediately after you wake up in the morning, before you get out of bed.

WORKSHEET — Sample graphs

Pulse Response to Exercise — Non-Athelete



Pulse Response to Exercise — Athelete



4. How does body size affect the pulse. Discuss the difference in pulse rates between the mouse and the elephant. The mouse (like other small mammals and birds) has a very rapid pulse, while the elephant has an extremely slow pulse. How is this related to the differences in the pulse rates of males and females of the same age and fitness level? How does the pulse rate of a newborn baby compare with that of an adult?

Homework: Use your biology textbook to help you complete this assignment.

1. How did your level of cardiovascular fitness compare with that of the other students within your own group? Within the class?

2. Develop an exercise prescription that you feel you can follow realistically, and which you feel can be used to improve your level of cardiovascular fitness? Write a paragraph containing both your exercise prescription and the goals which you feel you can achieve by following it? DO NOT FOLLOW THIS PRESCRIPTION WITHOUT CONSULTING WITH YOUR DOCTOR OR OUR GYM TEACHER.

Enrichment:

What factors, in addition to exercise, can affect the functioning of the human heart and the conditions within the heart and blood vessels?

TOPIC 60
Pathology, Diseases and Defenses

Aim: What are some common pathogens?

Performance Objectives: The students will be able to:

- define the term "infectious disease"
- name the major groups of pathogens
- describe the three types of bacteria and the diseases they produce
- describe the optimum conditions needed by bacteria for growth
- explain the paths that pathogens use to enter the body
- define the term toxin
- describe the structure of viruses
- name diseases caused by fungi and viruses
- name and describe pathogens of the worm group
- name and describe pathogens of the protozoan group

Materials:

- IBM computer lab using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Pathology: Diseases and Defenses - published by IBM
- worksheets associated with this lesson

Do Now:

List five diseases and describe each one. What causes a disease?

Motivation:

Review student responses to the 'Do Now'. Challenge the students to identify the type of pathogen which causes each of those diseases.

Development:

1. Explore the student answers to the motivational question. Use your knowledge of pathogens to guide them to name the correct pathogen for each disease.

2. Challenge the students to categorize the pathogens into just four or five groups. Steer the students to place the pathogens into their proper groups.

3. Explain the term "infectious disease" to the class. Ask the students to list the paths that pathogens use to invade the human body. Establish that pathogens are inhaled, ingested, or enter the body through wounds.

4. Ask the students to explain why the human body provides a desirable environment for pathogens to live and grow. Explore the various answers with the students.

5. Explain to the students that with the aid of computers you are going to help them obtain a clearer understanding of pathogens and infectious diseases.

6. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a screen identifying the program. In a few moments the menu to this program is revealed. Instruct the students to press the #1 key on top of the keyboard to enter the section of the program titled Pathogens.

7. Allow the students 10-15 minutes to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point.

8. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. What are infectious diseases.
2. Describe the major groups of pathogens.
3. Name the three shapes in which bacteria can occur.
4. What are the four main conditions which bacteria need for rapid growth?
5. What is a toxin?
6. What are viruses? What diseases do they cause?
7. Describe a tapeworm.
8. Describe some protozoan pathogens.

Homework:

1. Complete the worksheets associated with this lesson.

Enrichment:

1. Make a chart naming all the groups of pathogens and listing several diseases caused by each.

2. Tourists going to several foreign countries are warned to drink only water which has been boiled. What diseases can be transmitted if this advice is not followed?

3. Write a report on trichinosis. Describe the life cycle of the pathogen. What methods can be used to destroy the pathogen in the food we eat?

WORKSHEET — Bacterial Pathogens

Name ______________________ **Class** ________ **Date** _________

Part I - In the space provided below, make three drawings representing bacillus, spirillus and coccus bacteria. Label as many cell parts as you can.

BACILLUS COCCUS SPIRILLUS

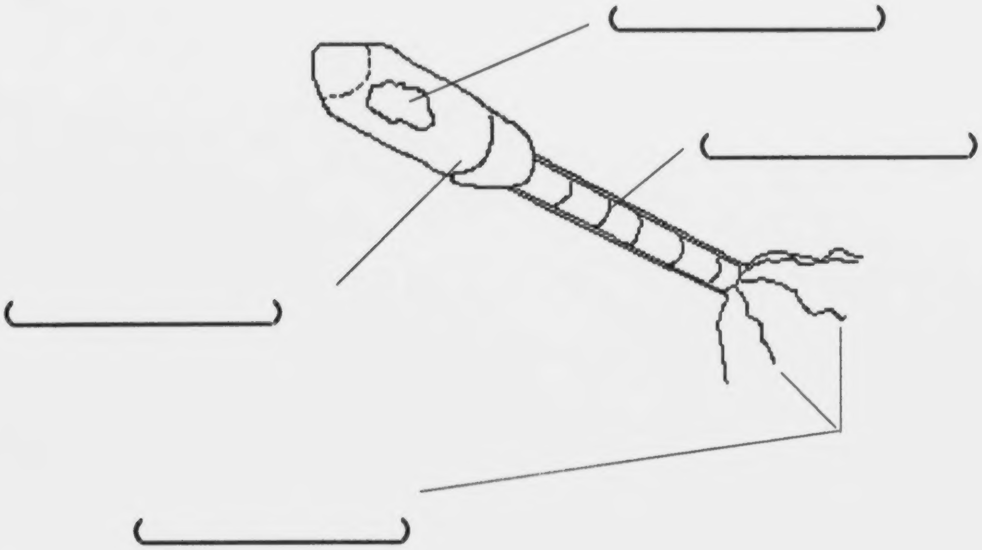
Part II - Completion questions.

1. Bacteria belong to the ____________ kingdom.
2. ______________ are agents which cause disease.
3. ________________ diseases are caused by pathogens which have invaded the body.
4. The three shapes of bacteria are __________, ____________, and ____________ .
5. _____________ are organisms that depend upon another organism and cause damage to that organism.
6. Rheumatic fever and scarlet fever are caused by _________ bacteria.
7. Tetanus and diphtheria are caused by ___________ bacteria.
8. Asiatic cholera and syphilis are caused by _________ bacteria.
9. The optimum temperature at which most pathogenic bacteria grow is _____ degrees centigrade.
10. _________ are poisons produced by bacteria.

WORKSHEET — Viral Pathogens

Name ____________________ **Class** ____________ **Date** __________

Part I - Below is a diagram of a typical virus. Label the parts of the virus.



Part II - Completion questions.

1. Viruses are surrounded by a layer of ______________.

2. Viruses are the pathogens which cause the common _______.

3. Many scientists do not consider viruses to be __________ because they are so dependent on living organisms for many of their functions.

4. Many viruses are _______ specific.

5. Many viruses __________ the cells of their hosts, while others attach themselves to the surface of the cells.

6. Two diseases caused by viruses are __________ and __________.

7. Viruses that have invaded a cell cause that cell to release ____________ that will burst the cell and release more viruses.

8. Viruses inject their ___________ acid into cells.

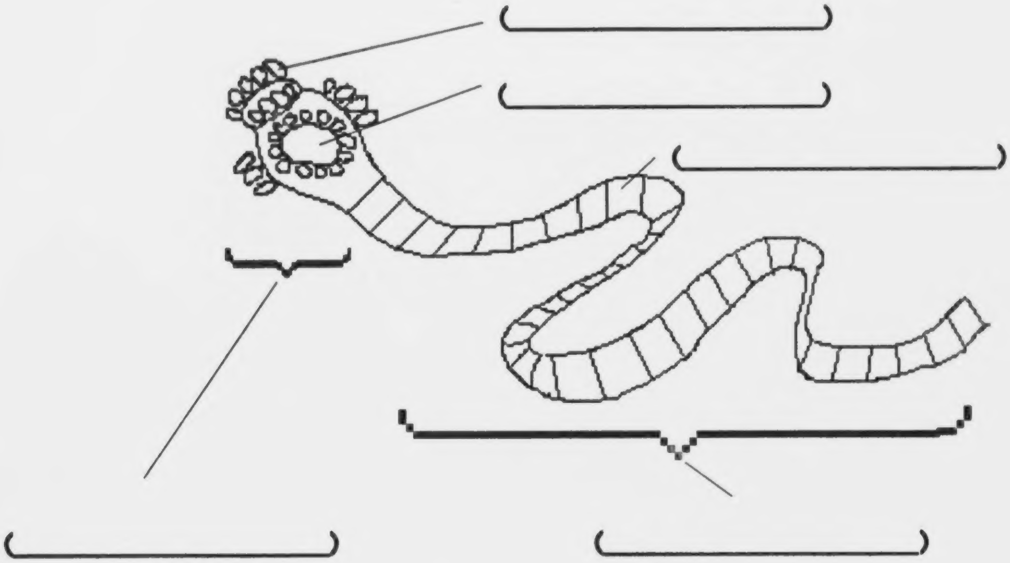
9. Viruses are too small to be seen with an ordinary ________ microscope.

10. Most viruses enter the human body when we __________ them.

WORKSHEET — Worms, Fungus, and Protozoan Pathogens

Name ______________________ **Class** ________ **Date** _________

Part I - Below is a diagram of a tapeworm. Label the two main sections of the tapeworm as well as the important head parts.



Part II - Completion questions.

1. Fungus pathogens often grow on the __________ of their human hosts.

2. ____________ and ___________________ are 2 diseases caused by fungus.

3. Protozoans most often enter the human host through the _________.

4. ___________ is a disease caused by a protozoa.

5. Protozoa belong to the ____________ kingdom.

6. Hookworm belong to the ___________ phylum.

7. Tapeworms belong to the ___________ phylum.

8. The _______ is another animal in which the tapeworm lives for part of its life cycle.

9. Tapeworms form _______ in the muscle tissue of infected animals.

10. Tapeworms are parasitic in humans. They live in the human ______________.

TOPIC 61
Immunity

Aim: How does the body fight pathogens?

Performance Objectives: The students will be able to:

. describe the three methods of body defense
. describe antibodies
. describe antigens
. describe the body defenses against viruses
. explain clumping
. contrast active and passive immunity
. define vaccination

Materials:

. IBM computer lab. using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
. one or two double-sided disk drives
. color monitors and graphics adapters
. printer (optional)
. software: Pathology: Diseases and Defenses - published by IBM
. worksheet associated with this lesson
. human torso model or chart

Do Now:

Ask the students to describe the body's main defenses against infectious diseases.

Motivation:

Display human torso or chart and ask the students to identify or describe the structures that keep out germs.

Development:

1. Explore the student answers to the motivational question. Guide the students to understand that the body's first defense against many infectious diseases is the unbroken human skin. The white blood cells and the immune system are also major lines of defense against infectious diseases.

2. Elicit from the class how the skin serves to protect the body from infection. Have the students name some pathogens which could enter the body through broken skin.

3. Review with the students the role of white blood cells (lymphocytes) in fighting diseases. On the board, draw a series of pictures representing phagocytosis. Which pathogens can lymphocytes destroy?

4. Briefly discuss the role of the immune system in destroying pathogens. Define the terms "antigens" and "antibodies." What is clumping and how does it aid lymphocytes?

5. At this time explain to the students that with the aid of computers you are going to help them obtain a fuller understanding of the body's defenses against infectious diseases. Material on the use of both passive and active immunity through vaccination will also be presented.

6. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk based software.

7. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up (load). This software package is self-loading.

8. The program commences with a blue screen displaying the IBM logo and then proceeds to a menu. Instruct the students to press the #2 key on the keyboard to enter: The Body's Defenses. Allow the students a reasonable amount of time to operate the program. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the activity.

9. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. What are the three main lines of body defense against infectious diseases?
2. What are antigens?
3. What are antibodies?
4. What are the functions of memory cells and plasma cells?
5. How are memory cells produced?
6. How does the body destroy viruses?
7. What is the purpose of vaccinations?
8. Describe both active and passive immunity.

Homework:

1. Complete the worksheet associated with this lesson.

Enrichment:

1. Write a report on the topic of rabies which answers the following questions:
   a) What animals transmit rabies to humans
   b) What methods are used to protect humans before they are bitten by an infected animal
   c) What methods are used to treat humans who have been bitten by an infected animal

2. Make a chart naming diseases that can be prevented by means of passive immunity.

3. Make a chart naming diseases that can be prevented by means of active immunity.

4. Write a report describing the first successful use of vaccination to prevent human disease.

5. What is polio? What are the different methods currently available to prevent this disease?

WORKSHEET — Immunity

Name ________________________ **Class** ________ **Date** _________

Part I - In the space provided below, draw a series of diagrams illustrating the process of phagocytosis.

Part II - Completion questions.

1. The body's three main defenses against infectious diseases are ____________________ , _________________ , and __________________ .

2. Many fungi produce ________________ that destroy bacteria.

3. ____________ are pathogens which are hard to destroy because they are not living cells.

4. ________________ are found on the surface of viruses and bacteria.

5. ___________________ rapidly respond if they encounter antigens which the body has encountered before.

6. ____________________ secrete antibodies.

7. Antibodies can cause the antigens of viruses to ________________ making it easy for lymphocytes to engulf them.

8. _____________ immunity is developed through the injection of dead or weakened pathogens.

9. _____________ immunity is developed through the injection of antibodies.

10. ___________________ is a method used to give immunity to humans and other animals.

TOPIC 62
Excretion in Humans

Aim: What are the adaptations for excretion in humans?

Performance Objectives: The students will be able to:

- describe the need for food and oxygen in human beings
- explain why waste results from the oxidation of nutrients to produce energy
- describe the relationship between the level of activity in a human being and the quantity of metabolic wastes produced.
- define the term "metabolic wastes" and distinguish between excretion and elimination
- identify the organs responsible for the excretion of metabolic wastes.
- describe the excretory functions of the skin, lungs and kidneys
- describe the functions of the structures within the kidneys and explain how the kidneys remove metabolic wastes from the blood
- explain how filtration and selective reabsorbtion occur within the kidneys
- describe the composition of urine and identify the substances normally found in urine

Materials:

- MS-DOS computer labs, DOS
- software: Human Life Processes 11: Systems Level, IBM software
- sample of artificial urine (tea and apple juice)
- urinalysis test stick
- chart of the organs of excretion found in humans
- worksheet containing a diagram of the organs of excretion

Do Now:

What would happen to an organism that loses its ability to excrete metabolic wastes?

Motivation:

1. Display the sample of artificial urine and ask the class: "Why is a urinalysis an important part of a physical examination?

2. Elicit student responses and list them on the chalkboard. Elicit from the students that the substances contained in urine provide the doctor with information on how well a person is able to oxidize nutrients and utilize the nutrients to provide energy for body activities.

3. As many students associate the urinalysis only with drug testing, the teacher should demonstrate the use of the urine test stick and identify some of the substances which are both normal and abnormal constituents of urine.

4. In addition to urination, what other methods are used by the human beings to excrete metabolic wastes? Use the chart to demonstrate how metabolic wastes are excreted through perspiration and exhalation as well as through urination.

5. Introduce the computer software and explain to the students they will use the computers to learn the structures and functions of the human excretory system.

Development:

1. Distribute the software and the DOS disks. If the students are not familiar with the operation of the computers inform them that they should not bend or fold the disks and should not place anything but the diskettes into the disk drive.

2. Instruct the students to insert the DOS disk into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. WARNING: The teacher should follow the instructions contained within the software documentation prior to the first operation of the program. A back-up disk must be prepared. Instructions are also provided for the preparation of self-loading program discs. This would eliminate the need for the DOS when the students load the programs on IBM computers.

3. After the program has loaded, the students are presented with a menu screen. Instruct the students to select section #3: The Excretory System. Allow the students sufficient time to complete this activity. This program requires a minimum of. 30 minutes of classroom time. The program provides the students with the information and tasks listed below. It also introduces the vocabulary of excretion and provides the students with the opportunity to consult the self-contained glossary during the instruction segments. The software documentation also contains a glossary.

4. This program contains provisions for printing a copy of the information which is displayed on the screen. This requires the use of a graphics printer. The instructions for this procedure is contained in the software documentation. This will permit the teacher to prepare printed copies of the diagrams and charts that are presented to the students during the operation of the program.

5. The students are introduced to the following concepts and have the opportunity to participate in these activities during the operation of the program.

   a. Waste is produced when an organism oxidizes food
   b. An "experiment" shows the students that the quantity of metabolic waste produced varies with a person's activity level. The students can vary the speed of a jogger and see the results in the quantity of waste produced.
   c. The metabolic wastes are excreted from the body through the skin, the lungs and the urinary system.
   d. Quiz - the students are tested on the material which they have learned and a "learning loop" makes them repeat the segment if they have more than two answers which are incorrect.
   e. The kidneys and kidney structures are examined in detail using graphics and animation. The students study the blood flow around a single nephron and observe changes in the composition of blood plasma as waste products are filtered. The students are questioned

of their ability to observe the process and interpret data presented on a chart.

f. The segment on the nephron examines the processes of filtration and reabsorbtion in detail and shows how water and nutrients are selectively reabsorbed through active transport.

g. The students are presented with a graphic of the urinary system and the program describes how the urine passes from the kidneys to the urinary bladder and out through the urethra.

h. The students are presented with a chart of the relative amounts of the filtered materials which are removed from the blood and are the constituents of urine. The teacher may use this for comparison with the student responses during the motivation.

6. At the conclusion of the computer activity, instruct the students to place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers and monitors.

Conclusion:

1. Distribute the worksheet and give the students an opportunity to label the parts of the urinary system and answer the questions on metabolic wastes, the organs of excretion, and the structures and functions of the human kidney.

Homework: Use your biology textbook to help you complete this assignment.

1. How does excretion differ from elimination? Why do biologists distinguish between the two processes for the removal of wastes from the body?

2. What are the metabolic wastes? Describe how each of these wastes results from the process of oxidation that occurs in body cells?

3. How does the excretory system help to maintain homeostasis?

4. Draw a sketch of the nephron and label each part. Describe how the nephron filters blood and explain what happens to the nutrients and wastes that are removed from the blood plasma?

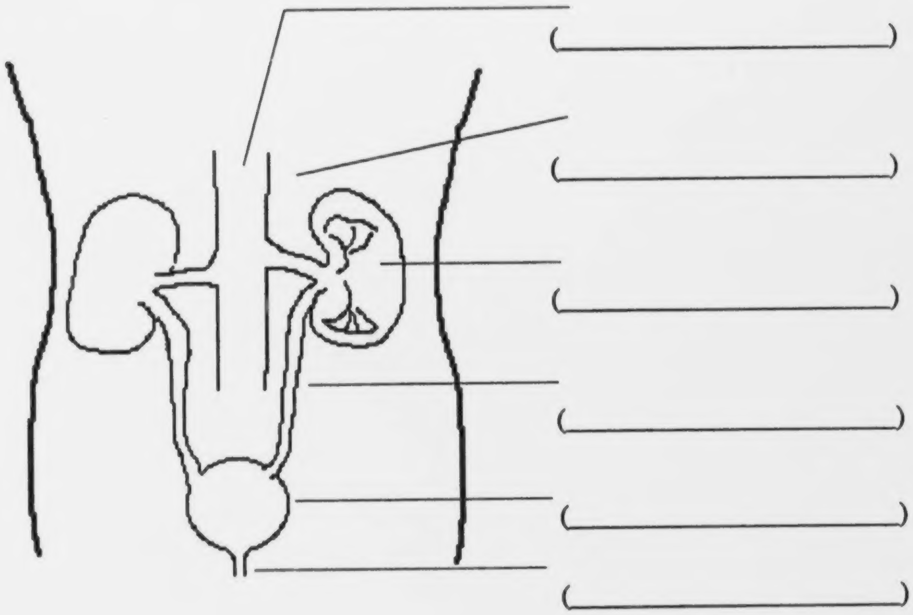
Enrichnment:

The urinalysis presents a physician with important information about the condition of a person's body. Investigate the medical uses of urinalysis and explain the causes and significance of each of the following abnormal results.

a) protein in the urine
b) red blood cells in the urine
c) glucose in the urine
d) an abnormal urine pH
e) an abnormal specific gravity reading

WORKSHEET — The Urinary System

Name______________________ Class __________ Date___________



Identify each of these structures:

Urinary bladder

Urethra

Ureter

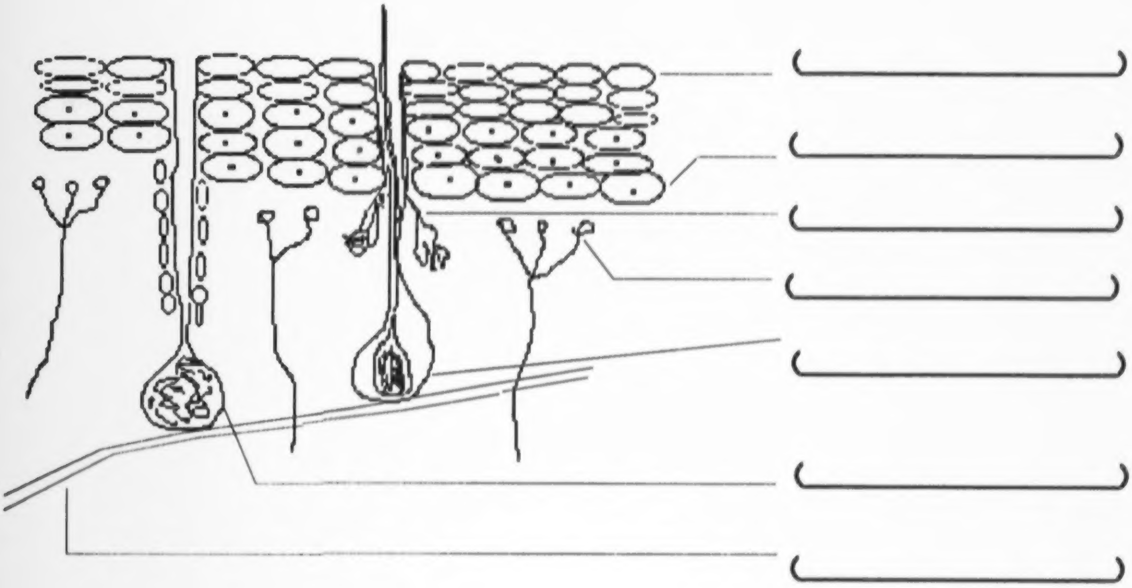
Kidney

Vein

Artery

WORKSHEET 2 — Excretion

Name ________________________ Class ________ Date _________



Identify each of the following above:

epidermis; dermis; oil gland (sebaceous gland); hair follicle; sweat gland; nerve ending; capillary

Answer these:

1) Why are the lungs called organs of excretion? What metabolic waste is excreted via the lungs?

2) Describe the composition of perspiration. What are the sweat glands called organs of excretion?

3) What are the excretory functions of the liver?

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TOPIC 63
The Human Nervous System

Aim: What are the structures and functions of the nervous system?

Performance Objectives: The students will be able to:

- recognize the structures of the nervous system
- locate and describe the functions of the organs of the nervous system such as the:
  - a. brain
  - b. sense organs
  - c. sensory and motor neurons
  - d. spinal cord
- understand the role of the brain as the thinking organ of the body
- describe a neuron and its parts
- explain the path of a reflex

Materials:

- Apple IIe computer lab (color monitor recommended)
- software: The Human Body: An Overview, publisher: BrainBank Inc.
- chart of the human nervous system

Do Now:

What are the functions of the brain?

Motivation:

Place the following on the chalk board:
Choose A or B

A		B
Stand!	or	Sit!

Development:

1. Discuss student responses to the Do Now and Motivation. Ask how they chose A or B. Which organ(s) were involved in the decision and what system(s) are responsible for information gathering and decision making?

2. Tell students that the program they are about to use will teach them about the parts of the nervous system, their function and how they help us in our every day activities.

3. Remind the students of the correct procedure in handling software and to make sure the <Caps Lock> is pushed in. Insert the disk into drive 1, close drive, turn monitor and computer power on. The program is self-loading.

4. When the menu appears, instruct students to select option #7, The Nervous System, also select speed when prompted. As the lesson progresses students have many opportunities to interact with the software by responding to a variety of questions.

5. Allow 30 minutes to complete the lesson.

6. Upon completion of the software portion of the lesson, advise students to remove the disk, place it in its protective sleeve, and turn the computer and monitor off.

Summary:

1. List the parts of the nervous system.

2. Name the sense organs. How do the sense organs transmit their messages to the brain?

3. Which neurons carry messages to the brain?

4. Which neurons carry messages from the brain to the muscles?

5. Compare what happens when you touch a hot stove to what happens when you decide to sweep the floor.

6. What is the function of the spinal cord?

Homework:

1. Draw and label a diagram of the central nervous system.

2. Name the functions of the nervous system.

3. How is a neuron like a telephone wire? How is it different?

4. What role does the brain have in reflex action?

5. How does the nervous system assist the muscular system in moving from place to place?

6. Compare and contrast a computer and a human brain.

Enrichment:

1. Close your eyes for five minutes (use a timer). Immediately afterwards record your thoughts and feelings.

2. Why do you have dreams?

3. What happens when someone is in a coma?

TOPIC 64
Nerves and Muscular Control

Aim: How do our nerves control our muscles?

Performance Objectives: Students will be able to:

- define neuron, sensory neuron, motor neuron, interneuron
- identify the parts of a neuron
- describe an involuntary reflex
- design and conduct experiments measuring variations in muscle tension using a microcomputer for data aquisition and recording
- explain how the electrical impulses that control muscle contraction can be measured on the surface of the skin using a microcomputer
- determine the variations in electrochemical potentials (nerve impulses) that result from physical activity, exposure to warm and cold environments and other experimental conditions

Materials:

- Apple computer with large display monitor or Apple computer lab
- Apple DOS 3.3
- laboratory hardware-HRM Microlab Interface, probes, sensors and connecting wires.
- software: Biofeedback Microlab by HRM Software
- lab sheets
- rubbing alcohol (70% alcohol) and cotton swabs
- chart or model of a nerve cell, chart of the human nervous system

NOTE: The hardware should be connected to each computer and the probes should be calibrated prior to the start of the activity if required. Instructions are included within the software documentation.

Do Now:

Define sensory neuron, neurotransmitter, interneuron, motor neuron, reflex

Motivation:

1. Display the chart or model showing a nerve cell. Introduce the students to the structures of the neuron and explain how an impulse is transmitted through the neuron.

2. Where does the impulse begin? What is its destination?

Development:

1. Review student definitions and ask the pupils to explain how a sensory neuron differs from a motor neuron? Elicit that the sensory neuron carries nessages from receptors in the skin and sense organs while the motor neuron carries impulses to muscles. Explain the role of the interneuron.

2. Ask the students to explain what happens when a muscle receives impulses from the motor neurons.

3. Select a student volunteer and demonstrate the knee jerk (patella) reflex. Challenge the students to explain what happened within the nervous system to cause the response that was observed.

4. Review students' responses and explain how impulses travel through the nerves during an involuntary reflex. Provide the students with several examples of involuntary reflexes.

5. Ask: What must occur before a muscle will contract? Elicit student responses and discuss the electrical potentials that are caused when nerve impulses reach muscles. Explain to the students that these electrical impulses are extremely small but can be detected with the use of sensitive electronic instruments.

6. Display the wire and sensors that are used to detect muscle tension and explain that when these sensors are connected to the computer it can detect the electrical potentials. The computer combines these individual electrical potentials and presents us with a graph that reflects the overall level of communication between motor neurons and muscles or muscle tension.

7. Challenge the students to explain the relationship that exists between muscle tension and the number of impulses a muscle receives.

8. Introduce the computer activity. This activity can be performed as a laboratory activity, with the students working in groups or can be performed as a demonstration using a single computer and several volunteers. Place the disc in the drive and turn on the computer and monitor. When presented with the menu instruct the students to select "muscle tension (EMG)". The program will now present the students with the main menu.

9. Ask the students: Where should we attach the probes to a subject to monitor muscle tension. Elicit student responses and list them on the board. If the class is using a single computer select a volunteer and attach the electromyograph sensors to the student's forehead. Cleanse the sensors with alcohol prior to placing it against the student's skin. Press key #1 and the computer will start recording data and present the students with a scrolling strip chart. The computer acts as if it is a strip chart recorder. The computer contains options that permit the user to center the graph, zoom in or pull back to show small changes or keep graphs with large variations from going off th screen.

10. Instruct the subject to tense forehead muscles and then relax. Allow the members of the class to observe the changes that take place. If the computer is equipped with a printer and graphics board it is possible to make a printed copy of the graph.

11. Try several of the experiments and body sites suggested by the students. It is suggested that you place the sensor over a student's biceps muscle and record the data while the student relaxes the muscle, flexes it and performs a repeated arm exercise such as a biceps curl using a dumbell.

Continue monitoring the muscle tension for several minutes following the activity or exercise. Perform additional demonstrations or experiments if time permits. Do not permit a student who is medically excused from gym to exercise with the weight.

A. Ask the students: What body sites produced the highest and lowest readings? What is the relationship between the graphs recorded and the relative size or strength of the muscle group that was selected? What variations occurred in the measurements conducted on different people?

B. How did the electromyograph of a sustained muscle contraction differ from a series of repeated contractions and relaxations? Was muscle fatigue observed in the electromyograph?

C. How does the electromyograph of a reflex action differ from that of a voluntary muscular contraction?

12. At the conclusion of the computer actvity, instruct the students to disconnect the probes and place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers.

Summary:

1. How do nerve impulses travel through the nervous system?
2. How does a reflex action differ from a voluntary motion?
3. How can we monitor or record the electrical activity of the motor neurons?
4. Why do variations in muscle tension occur when the electromyograph is connected to different sites?
5. What causes a muscle to contract?

Homework: Use your biology textbook to help you complete this assignment.

1. How do impulses travel through neurons?
2. What is the function of a neurotransmitter?
3. What causes a muscle to contract?
4. What should happen if a muscle removed from a dissected frog was subjected to an electrical current? Why?

Enrichment:

Develop an original experiment which uses the electromyograph to monitor conscious control of individual muscle groups. Identify all variables and investigate the effects of training on muscle control. Perform the experiment with the permission of your teacher and report the results to the class.

TOPIC 65
Biofeedback

Aim: Can we learn to control involuntary physiological responses?

Performance Objectives: Students will be able to:

- define: conditioned behavior
- describe Pavlov's conditioning experiments
- explain the term biofeedback
- explain how biofeedback can be used in conditioning experiments

Materials:

- Apple computer with large display monitor or Apple computer lab
- Apple DOS 3.3
- laboratory hardware - HRM Microlab Interface, probes, sensors and connecting wires.
- software: Biofeedback Microlab by HRM Software
- rubbing alcohol (70% alcohol) and cotton swabs

NOTE: The hardware should be connected to each computer and the probes should be calibrated prior to the start of the activity if required. Instructions are included within the software documentation.

Do Now: define- conditioned behavior, learning, involuntary action

Motivation:

What would happen within this classroom if the bell rang right now? Why? Instruct the students to write a short paragraph answering this question.

Development:

1. Elicit student responses to the motivation. Introduce the term "conditioned behavior" and discuss Pavlov's experiments. Explain that Pavlov's dogs were conditioned to salivate in response to a bell. How is this similar to the way that students respond to the sound of a bell?

2. Why do fish in a tank often swim to the top of the tank when a person turns on the light? Why have the fish become conditioned to exhibit this behavior?

3. What is the role of reward in the development of conditioned behavior? How does an intrinsic reward differ from an extrinsic reward?

4. Introduce the term biofeedback and explain that we can use biofeedback as a form of intrinsic reward when attempting to develop a conditioned behavior. Explain that we can use a computer to detect physiological changes that occur in the body and use the data as a form of biofeedback. What physiological changes might be observed in a person that is trying to relax. Elicit student responses and list them on the board. Responses may include reduced pulse rate, lowered muscle tension etc...

5. Introduce the computer activity and explain that the computer can be used to monitor physiological responses and can be used like a window to show changes that occur within the body. Display the wire and sensors that are used to detect muscle tension, galvanic skin response, skin temperature and pulse rate. Explain that when these sensors are connected to the computer it can detect the small electrical currents or changes in temperature that occur and can present us with a graph that reflects the changes that occur within the body. This activity can be performed as a laboratory activity, with the students working in groups or can be performed as a demonstration using a single computer and several volunteers.

6. Ask: Can a person learn to relax? Instruct the students to develop a short experiment using the computer that will assist a person in becoming conditioned to relax. Instruct the students to identify all variables. Discuss student responses and ask the students whether there are any limitations that may prevent the class from performing a relaxation experiment in a single class period. Elicit that an activity must be repeated many times over an extended period of time before it becomes a conditioned behavior. Explain that we can observe the physiological effects of relaxation but a person will not become conditioned to relax unless the person practices the relaxation repeatedly while monitoring the physiological changes.

7. Can we learn to control "involuntary" physiological responss? Elicit student responses and introduce the students to the measurement of electrodermal activity (galvanic skin response). Explain to the students that it is a measurement of the electrical conductivity of the skin and it varies with sweat gland activity. The level of electrodermal activity varies with small changes in the rate of perspiration. If this is being performed as a classroom demonstration select a student volunteer and connect the leads to the fingertips according to the instructions provided. Wash the contacts with alcohol prior to use.

8. Place the disk in the drive and turn on the computer and monitor. When presented with the menu instruct the students to select "EDA-Electrodermal Activity. The program will now present the students with the main menu.

9. Press key #1 and the computer will start recording data and present the students with a scrolling strip chart. The computer acts as if it is a strip chart recorder. The computer contains options that permit the user to center the graph, zoom in or pull back to show small changes or keep graphs with large variations from going off the screen. These adjustments are made by selecting "R" (range options) from the chart recorder screen.

10. Instruct the subject to attempt to control the electrodermal activity of the fingertips while watching the change in the computer screen. The program also provides the option of generating a tone which varies with the data being monitored. Allow the student several minutes to try to control electrodermal activity and give several other students the opportunity to repeat the measurements.

11. Allow the members of the class to repeat the activity while attempting to control their pulse rates, muscle tension and skin temperature. The teacher may wish to spend several days on this activity permitting the students to develop experiments measuring each of the physiological functions monitored by the program. Allow the class to observe the changes that take place. If the computer is equipped with a printer and interface board it is possible to make a printed copy of the graph. These can be reproduced for analysis by the class during subsequent lessons.

12. At the conclusion of the computer actvity, instruct the students to disconnect the probes and place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers.

Summary:

1. What is a conditioned activity?
2. What is necessary for a learned activity to become a habit or conditioned behavior?
3. How can biofeedback be used to develop conditioned behaviors?
4. What is an "involuntary" physiological function? How can an involuntary function be controlled?

Homework: Use your biology textbook to help you complete this assignment.

1. Write a report on Pavlov and his experiments with conditioned behavior.

Enrichment:

Investigate the techniques which can be used to train animals using conditioned bahvior. Discuss whether "learning" differs from conditioned behavior.

TOPIC 66
Stress

Aim: How do human beings respond to stress?

Performance Objectives: Students will be able to:

- describe the physiological responses to stress that are exhibited in humans
- distinguish between the sympathetic and parasympathetic divisions of the nervous system
- explain how the sympathetic nervous system produces stress responses
- describe techniques used to monitor physiological responses to stress

Materials:

- Apple computer with large display monitor or Apple computer lab
- Apple DOS 3.3
- laboratory hardware-HRM MICRO/scope INTERFACE, probes, sensors and connecting wires. Printer and interface card (optional)
- software: Experiments in Human Physiology by HRM Software
- blindfold, inflated balloon, straight pin
- rubbing alcohol (70% alcohol) and cotton swabs

NOTE: The hardware should be connected to each computer and the probes should be calibrated prior to the start of the activity if required. Instructions are included within the software documentation.

Do Now:

How does a polygraph (lie detector) determine whether a person is telling the truth?

Motivation:

Select a quiet, well-behaved student who arrived in class on time and tell the student that you are writing a referral card or taking some other punitive action. Sit down at the desk and start performing the action that you just threatened. Try to encourage the student to react or exhibit a "fight or flight" response to your accusation.

Developmenmt:

1. Tell the class that you just performed a demonstration and call upon another student. Ask the student to explain how the subject of the motivation reacted. Introduce the words "stimulus" and "response" and explain to the class that the accusation caused a stress response in the subject.

2. Ask the students to explain what physiological reactions occur when a person is placed in a stressful situation. Elicit student responses and list them on the board.

3. Refer back to the "Do Now" and call upon students to read their answers. Elicit that a polygraph does not "know" whether a person is actually telling lies but monitors physiological responses that occur as a result

of stress. Pose the question "Is a lie detector always 100% accurate?" Allow student discussion on the subject.

4. Introduce the computer equipment and explain that the computer can be used to monitor physiological responses and can be used like a polygraph to show display changes that occur within the body. If the students are not familiar with the equipment, display the wire and sensors that are used to detect respiration, skin temperature, galvanic skin response and pulse rate. Explain that when these sensors are connected to the computer it can detect the small electrical currents or changes in temperature that occur in a living organism and can present us with a graph that reflects the changes that occur. This activity can be performed as a laboratory activity, with the students working in groups or can be performed as a demonstration using a single computer and several volunteers.

   A. Follow the instructions within the software documentation to prepare the computer to monitor data in the "polygraph" mode. An event marker "E" can be placed on the screen when the subject is subjected to a stress.

5. Select a student volunteer and explain to the class that you will connect the student to the computer interface and graph the student's heart rate, respiration rate and skin temperature. Follow the instructions contained within the software documentation for the polygraph mode. Record data for a period of several minutes until the readings are stable. Continue recording data while you proceed with the next segment of the activity. Instruct the student assistant to record the time when the blindfolding occurred and the time when the stressful event occurred.

6. Explain to the class that you will now subject the volunteer to a stress and allow the class to observe the physiological responses that result. Select an additional volunteer and instruct this volunteer to place a blindfold over the experiment subject. Tell the class that they should not laugh or make other noises while you are preparing to subject the student to the stress. Remind them that silence within the classroom adds to the tension and stress responses of the subject. Take an inflated balloon out of your closet and pop it with a straight pin several inches away from the student subject. Instruct the student subject to remain seated for several additional minutes so that you can record the recovery data. At the completion of the recovery disconnect the probes from the student subject.

7. If the computer is equipped with an interface board and printer, the teacher may wish to prepare a printed copy of the data. The software can print graphs of the recorded data. Instructions are included within the documentation.

8. Ask the students to explain what they observed on the computer monitor when the student was exposed to stress. When did the stress begin? How did the student respond to the silence before the balloon was popped? Why did the silence create anxiety?

9. Challenge the students to explain how the subject's body reacted to stress. Introduce the terms sympathetic nervous system and parasympa-

thetic nervous system. Define each term and tell the students that the sympathetic nerves produce the responses needed for periods of stress while the parasympathetic nerves produce responses appropriate for periods of calm. Explain that the sympathetic nervous system is responsible for "fight or flight" responses in human beings. Discuss the release of the neurotransmitters acetylcholine and noradrenaline.

10. Ask: How does the endocrine system react to stress? Introduce the word "adrenalin" and discuss the expression "gland of combat." How does the adrenal gland work in conjunction with the nervous system to help us deal with emergency situations? What may happen when a person is subjected to stress but does not have an opportunity to react?

Summary:

1. What is stress?
2. What physiological responses occur as a result of stress?
3. Why may a person subjected to a stressful life suffer from high blood pressure or other physical problems?
4. What is the sympathetic nervous system?
5. How does the sympathetic nervous system trigger the "fight or flight" response?
6. Why does a person exposed to stress often become involved in fights?

Homework: Use your biology textbook to help you complete this assignment.

1. Explain the functions of the parasympathetic and sympathetic nervous systems.
2. How are neurotransmitters responsible for human stress responses?
3. How does the nervous system interact with the endocrine system during periods of stress?

Enrichment:

Investigate how a polygraph operates. Research the history of the lie detector amd report upon the physiological responses that are monitored by modern polygraph machines. Can a polygraph machine be fooled?

TOPIC 67
Human Response Time

Aim: What factors determine our response time to external stimuli?

Performance Objectives: Students will be able to:

- design and conduct experiments measuring the response to external stimuli using a microcomputer for data aquisition and recording
- determine how response time varies in different individuals
- determine whether individuals repond faster to auditory or visual stimuli
- explain how alcohol or drugs can slow response time and create dangerous conditions when driving

Materials:

- Apple computer with large display monitor or Apple computer lab
- Apple DOS 3.3
- laboratory hardware - HRM MICRO/scope box timer plug and probes, connecting wires
- software: Experiments in Human Physiology by HRM software
- rexographed lab sheets
- a milk crate or other platform approximately 12 inches tall

NOTE: The hardware should be connected to each computer prior to the start of this lab activity. Instructions are included within the software documentation. See page 19 for instructions on setting up the hardware for this activity.

Do Now:

define each of these terms: stimulus, response, auditory, visual, motor neuron, sensory neuron, reflex.

Motivation:

Select a student volunteer and ask the volunteer to step outside the classroom. Inflate a balloon and explain to the class that you will pop it behind the volunteer unexpectedly. Instruct the students to observe how the volunteer responds to the external stimulus. Review the student definitions for the "Do Now" vocabulary. How did the volunteer respond to the auditory stimulus of the popping balloon?

Development:

1. Display a single Apple computer equipped with the HRM MICRO/scope box and hardware for response time measurement. Load the software "Experiments in Human Physiology." Explain to the students how the computer can be used to measure the response time by presenting a stimulus on screen and recording the time that passes until the student responds by pressing the appropriate key or the space bar. Select a student volunteer and demonstrate the measurement of response time to a visual stimulus using the computer.

NOTE: The response time experiments can be performed as laboratory activities with the students working in groups or they can be performed as demonstrations using a single computer and several volunteers.

1. Ask the students to suggest one or more experiments that can be performed using the computer to monitor and record reactions to stimuli. List these experiments on the board and discuss the procedures that could be used to perform each of the experiments. Challenge the students to develop practical applications for measurement of response time using electronic devices.

2. Distribute the laboratory worksheet and explain to the students that they will perform experiments to measure the response time to various external stimuli.

3. Instruct the students to load the software and select "Response Time" by entering #1 from the keyboard. The students will be presented with a screen containing two sets of graph axes and a small menu containing data aquisition controls. Use "S" for start, "M" for menu and "E" for erase. Instruct the students to depress "M" to obtain the Response Time main menu.

4. Instruct the students to select "A" "Select Stimulus". The students can now select #1 "Sound,from Speaker." Instruct the students to select "B" "Select Response" Select option "K". This gives the students the opportunity to strike any key or the space bar to register a response. Enter "T" to select the number of trials. For the first experiment allow the student to try 15 trials.

5. Each pupil to be tested should sit down comfortably in front of the computer and touch a key or the space bar every time that the computer generates a tone. Each student should have 15 trials. Record each student's average response time, and minimum and maximum response times before erasing the data on the screen and starting the test for the next student. The students should determine whether the responses to the auditory stimulus are consistent or variable, and whether trends or patterns can be observed in the recorded data.

6. After the students in the lab group have all had an opportunity to try the auditory test instruct the students to enter "M" and go back to the "Response Time" menu. Instruct the students to change the stimulus. By selecting option #2 the students will receive a visual stimulus. The computer will provide a stimulus by lighting the red LED on the MICRO/scope box. Instruct the students to strike any key or the space bar whenever the red light goes on. Conduct a second series of experiments using the same students.

7. If time permits, many other experiments can be performed using different stimuli and responses. The computer can present the students with varying tones or symbols on the computer screen. The light sensor can also be used as a response detector.

8. At the conclusion of the computer activity, instruct the students to disconnect the probes and place the diskettes back into their protective envelopes, close the disk drive doors and shut off the machines.

Summary:

1. Answer these questions based upon the experimental results:
    A. Do people tend to respond more quickly to auditory or visual stimuli?
    B. Did the pitch or sound of the auditory signal affect the response time?
    C. Did patterns emerge which presented evidence of "learning" or "fatigue"?

2. How can the knowledge of human response to stimuli be used to develop safer automobiles and industrial machines?

3. What are the effects of drugs or alcohol upon response time?

Homework: Use your biology textbook to help you complete this assignment.

1. Describe the mechanisms that regulate or control the response time of human beings to external stimuli.

2. Do humans always respond to external stimuli in the same way. Compare a reflex response with the process of conscious thought?

3. What is a "conditioned reflex?" Are the experiments performed in this series of activities examples of conditioned reflexes?

Enrichment:

1. Investigate the physiological affects of alcohol, cocaine, marijuana or other drugs on the human nervous system. Why do each of these substances affect response time?

2. Does age affect response time? Conduct a study to determine whether significant differences exist in the response times of people of different ages.

3. The experiments that were conducted operate in a way that is similar to many video games. Do students that play video games frequently demonstrate faster response times to external stimuli than students that do not play those games?

WORKSHEET — Student Response Time Data Sheet

Date ________ **Subject** _______________ **Recorder** _______________

Experiment 1 - Auditory Stimulus

minimum time ____________________

maximum time ____________________

average time ____________________

Observed pattern or trend

Experiment 2 - Visual Stimulus

minimum time ____________________

maximum time ____________________

average time ____________________

Observed pattern or trend

Conclusion: Observed differences between reaction to auditory and visual stimuli: ____________________

TOPIC 68
Nervous System and Endocrine System Interaction — 1

Aim: How do the nervous and endocrine systems interact to maintain homeostasis in humans?

Performance Objectives: Students will be able to:

- explain the fundamental interactions that maintain homeostasis in humans
- demonstrate how the human nervous system responds to stimuli
- identify and label the major parts of the human brain
- describe the functions of each of the major parts of the human brain
- explain how the medulla helps to maintain homeostasis
- describe the relationship that exists betwen the human brain and the pituitary gland

Materials:

- MS-DOS computer labs
- software: Regulation and Homeostasis: Systems in Balance by IBM Software
- a model of the human brain
- a chart of the endocrine glands

Do Now:

Define: endocrine system, pituitary gland, homeostasis, brain

Motivation:

1. Display the model of the human brain. Separate the model into its three sections and ask the students to identify the functions associated with each section of the brain.

Development:

1. Introduce the terms: medulla, cerebellum and cerebrum. Review student responses to the motivational question and describe the functions of the medulla, cerebrum and cerebellum.

2. Challange the students to explain how the brain serves to maintain homeostasis? How can the brain obtain information about conditions in blood vessels? Introduce the term "hypothalamus" and describe its function.

3. Display the chart of the endocrine system and introduce the students to the endocrine glands. Explain that the endocrine glands are called ductless glands because they release their secretions directly into the bloodstream. Emphasize that although the glands are not physically connected, they interact.

4. Ask the students to identify the functions of the pituitary gland. Elicit that it is often called the master gland because its secretions control many other glands. Ask the students to identify the relative locations of the hypothalamus and pituitary glands. Explain that interaction occurs between the central nervous system and the endocrine

system.

5. At this point inform the students that they will use the computers to learn more about the interactions that occur between the nervous system and endocrine system to help maintain homeostasis.

6. Distribute the software. If the students are not familiar with the operation of the computers inform them that they should not bend or fold the disks and should not place anything but the diskettes into the disk drive. Instruct the students to insert the disks into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. The program will be self-loading if the teacher followed instructions to prepare a self-loading disk prior to the first use of the program.

7. This program explains the roles of the nervous systems in maintaining homeostasis and emphasizes the interaction that occurs between the two systems. An animated graphic depicts a beating heart and allows the students to stimulate nerves and see how the heart responds to the stinmuli. This section shows the functions of the sympathetic and parasympathetic nerves that connect the medulla and the heart. The program provides the students with information on the endocrine system and depicts how the posterior pituitary and hypothalamus communicate. The program also explores the functions of five endocrine hormones through the use of an animated graphic. The students must select each of the hormones before leaving this segment of the program. This segment of the program ends with a review of the content and a multiple choice quiz.

8. At the conclusion of the computer actvity, instruct the students to place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers and monitors.

Summary:

1. How do the endocrine system and the nervous system interact to maintain homeostasis?

2. What are the functions of the pituitary hormones?

3. What are the functions of the three major parts of the brain?

4. How does the human brain help to maintain homeostasis?

Homework: Use your biology textbook to help you complete this assignment.

What are the functions of each of these endocrine hormones?
GH (growth hormone)
TSH (thyroid stimulating hormone)
LH (luteinizing hormone)
FSH (follicle stimulating hormone)
ACTH (adrenocortiotropic hormone)
Oxytocin
Vasopressin

Enrichment:

List the endocrine glands and describe the functions of each. Describe the abnormalities that result from the undersecretion or oversecretion of hormones from each of these glands.

Investigate hypoglycemia and hyperglymecia. Describe the causes of these conditions and explain why the pancreas may be classified as both a duct gland and a ductless gland.

TOPIC 69

Nervous System and Endocrine System Interaction — 2

Aim: How do the hypothalamus and pituitary glands help maintain homeostasis in the body?

Performance Objectives: Students will be able to:

- define the terms regulation, homeostasis, and feedback
- explain how the nervous system responds to stimuli
- identify and label the major parts of the brain and describe their functions
- describe how the medulla helps the body to maintain homeostasis
- explain the functions of the sympathetic and parasympathetic nerves and describe how they help to control heartbeat and blood pressure
- define the term "endocrine system"
- identify the hypothalamus of the brain
- describe the unique relationship that exists between the brain and each lobe of the pituitary gland
- list the pituitary hormones and their effects on the body

Materials:

- IBM computer lab
- software: Regulation and Homeostasis: Systems in Balance by IBM
- model of the brain
- class set of diagrams showing details of relationship between hypothalamus and the pituitary gland
- overhead projector and transparency of home heating system
- model or transparency diagram of a thermostat

Do Now:

Define: endocrine system, regulation, homeostasis

Motivation:

Show the the class a transparency of a home heating system. Briefly discuss and elicit from the class the need to control this system in the home. Elicit the analogy of regulation in the body and the need for homeostasis.

Development:

1. Review the function of a thermostat. Bring out in discussion its analogy to those of the pituitary and hypothalamus in controlling the amount of hormones they secrete in order to maintain homeostasis.

2. Elicit or explain the terms feedback and target cells.

3. Summarize the discussion and tell students that the program they are about to see will teach them the major parts of the nervous system, how it responds to stimuli and helps maintain homeostasis. The program will also outline the main parts of the endocrine system, will emphasize the relationship between the hypothalamus, a part of the brain and the pituitary endocrine gland. It will allow them to explore a variety of

hormones in order to learn their functions in the body.

4. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

5. When the menu appears on the screen, instruct the students to select option #3 - Nervous and Endocrine Interaction.

6. The computer-directed instruction starts with a brief introduction as to how homeostasis is maintained in complex animals. A series of animated graphics teaches about the nervous system and how it responds to stimuli as well as the structure of the endocrine system and the role of the hormones.

7. The next subsection contains a series of animated graphics that describes the ways that the nervous and endocrine systems interact and shows how pituitary gland secretions influence other parts of the body.

8. Students are provided an opportunity to select which pituitary gland hormones they wish to investigate. Each investigation elaborates on the role of the hormone and the feedback mechanism that controls its secretion.

9. The section concludes with a brief review of the function of sympathetic and parasympathetic nerves and the role of endocrine and nervous system interaction. An additional review screen summarizes the major pituitary hormones and their effect on the body. The section ends with a six-question matching quiz.

10. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained information screen. Suggested time is 10-15 minutes. Instruct the students to stop the program at the end of the matching quiz, to remove the disk from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers carefully without touching the recording surface.

Summary:

1. What is meant by the terms regulation, homeostasis, and feedback
2. How does the nervous system respond to stimuli?
3. What are the major parts of the brain?
4. What are the functions of each major part of the brain?
5. How does the medulla help the body maintain homeostasis?
6. Why is there a need for both sysmpathetic and parasympathetic nerves?
7. How do these nerves help control heartbeat and blood pressure in the body?
8. What is meant by the term "endocrine system"?
9. What is the general location of the hypothalamus of the brain?
10. How would you describe the unique relationship that exists between the brain and each lobe of the pituitary gland?
11. What are the pituitary hormones?
12. What effects do these hormones have on the body?

Homework:

1. Assign students to study appropriate sections in textbook on the hypothalamus and the pituitary gland including their hormones and their functions.

2. Describe how regulation, homeostasis and feedback are carried on by the interaction between the nervous and endocrine systems.

3. Name the hormones of the pituitary gland, their functions, and describe the feedback mechanism that controls their secretion.

Enrichment:

1. Explain why homeostasis is considered to be a fundamental adaptation for survival.

2. Research and report to the class on the relationships that exist between each of the following pairs of hormones:
   a. Thyroxin and TSH
   b. FSH and estrogen
   c. Epinephrine and insulin

TOPIC 70
Cell Growth

Aim: How large can a cell grow?

Performance Objectives: The students will be able to:

- identify and name the parts of a typical cell
- explain the function of a cell membrane
- explain the relation between surface area and volume
- explain the effect that increased volume and surface area has on the transport of nutrients and wastes

Materials:

- IBM computer lab using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Cell Growth and Mitosis by Classroom Consortia Media Inc.

Do Now:

What are the characteristics of a typical cell?

Motivation:

Ask the students to name the largest cell they know. Then ask the class if there are limits to the growth of normal cell.

Development:

1. Elicit from the students several answers to the first motivational question. The answer to the question is an ostrich egg.

2. Explain to the students that the ostrich egg is a special cell. A large amount of the egg consists of food to be used by the developing embryo. Soon after fertilization the zygote will begin to undergo cleavage. This is the first step to becoming a multicellular organism. This is a normal stage in the development of every embryo.

3. Ask the students if they can determine whether there are limits on cell size. Guide the students to understand the relationship between a cell's volume and its surface area.

4. Challenge the students to describe the function of the cell membrane. Guide them to understand that it controls the transport of nutrients and waste material in and out of the cell.

5. Ask the students to determine the effect that increased cell volume would have upon the amount of material passing through the cell membrane.

6. Explain to the students that with the aid of computers you will help them obtain a better understanding of the relation between cell volume and surface area. This relationship is the key to understanding the limits of cell size and cell growth.

7. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to load.

8. The program commences with the software logo and then automatically proceeds to a screen identifying the program. In a few moments the menu to this program is revealed. Instruct the students to press the #1 key on the keyboard to enter the section of the program concerned with the Surface Area/Volume of Cells.

9. Allow the students a reasonable amount of time to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you wish to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point. After this message, the software goes on to discuss material not covered in this lesson.

10. At the completion of the computer guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. What are the basic parts of a typical cell?
2. What is the function of the cell membrane?
3. What is the relation between cell volume and surface area?
4. How does the need for nutrients change as the volume changes?
5. How does the need to rid the cell of wastes change as the cell volume increases?

Homework:

1. Draw a typical cell. Label the parts of the cell.
2. Describe the two main functions of the cell membrane.
3. How does the surface area of a cell change as its volume increases?
4. As a cell grows larger, describe how its need to take in nutrients and remove wastes changes.

Enrichment:

1. Draw a diagram of several different types of cells found in the human body - e.g. red blood cell, muscle cell. Which type of cell has the largest volume? Which type of cell has the greatest surface area?

2. What methods can be used to increase the surface area for a given volume? (Hint - the surface area of the lungs is equal to the surface area of a tennis court. What is the internal structure of the lungs?)

TOPIC 71
Factors Causing Cell Division

Aim: What factors cause a cell to divide?

Performance Objectives: The students will be able to:

- explain the relation between increased cell volume and increased surface area
- explain why the cell must divide as it grows larger

Materials:

- IBM computer lab using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Cell Growth and Mitosis by Classroom Consortia Media Inc.

Do Now:

When you blow up a balloon how does it increase in size? Which increases faster - its volume or its surface area?

Motivation:

Ask the class if the surface area of a cell increases at the same rate as the volume, as the cell grows or increases in size.

Development:

1. Elicit from the students several answers to the motivational question. Explore several of the answers with the class.

2. On the board draw several circles of increasing diameter. Use these circles to help the students visualize the relation between increasing volume and increasing surface area. You should explain to the students that the diagrams are two-dimensional representations of the spherical cells.

3. Guide the students to understand that as the cell's volume increases, its surface area does not increase at the same rate.

4. Ask the students to identify the materials which must pass through the cell membrane.

5. Challenge the students to describe how the cell's need to transport nutrients and wastes through the cell membrane will change as the cell's size increases?

6. Ask the students to explain what will happen to the cell if it doesn't receive sufficient nutrients? What will happen to the cell if it doesn't rid itself of wastes?

7. At this time explain to the students that with the aid of computers you are about to help them obtain a better understanding of the factors which led to cell division.

8. Remind the students of the basic procedures of computer operation. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up (load).

9. The program commences with the software logo and then automatically proceeds to a screen identifying the program. In a few moments the menu to this program is revealed. Instruct the students to press the #2 key on the keyboard to enter the section of the program: Experimenting With the Size of Cells.

10. Allow the students a reasonable amount of time to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you wish to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Name the materials which pass through the cell membrane of a cell.
2. How does the ratio of volume to surface area change as a cell grows larger?
3. What factors make it necessary for a cell to divide?

Homework:

1. What materials move into a cell through the cell membrane?
2. What materials must the cell rid itself of?
3. How does the ratio of surface area to cell volume change as the cell grows larger?
4. Explain why a cell must divide as it grows larger.
5. What would happen to a cell which did not divide as it grew larger?

Enrichment:

1. Make a graph clearly showing the relationship between increasing volume and surface area in a sphere.

2. Are all the cells in the human body capable of dividing to reproduce? Are there any cells in the human body which do not increase in volume as they mature?

3. What happens to the ratio of volume to surface area as when a cell divides to form two cells?

TOPIC 72
Chromosomes and Mitosis

Aim: What is the function of the chromosomes in mitosis?

Performance Objectives: The students will be able to:

- state that every organism has a specific number of chromosomes
- state that chromosomes occur in pairs
- state that each chromosome pair controls hundreds of traits
- define the term homologous chromosomes
- explain the process of replication
- explain the terms parent cell and daughter cell

Materials:

- IBM computer lab using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Cell Growth and Mitosis by Classroom Consortia Media Inc.
- chart of a typical cell
- worksheet

Do Now:

What are chromosomes? Where are they found?

Motivation:

Show the chart of the typical cell to the class. Ask the students to point out the chromosomes on the chart. Then challenge the students to give the number of chromosomes found in each body cell of a human.

Development:

1. Elicit from the students the answer to the motivational question. Then ask the class if all animal and plant cells have 46 chromosomes.

2. Again elicit several responses from the students. Guide the class to understand that every species of animal and plant has a specific number of chromosomes.

3. Explain to the class that chromosomes occur in pairs. When we say that human body cells contain 46 chromosomes, it would also be correct to state that the cells have 23 pairs of chromosomes.

4. Explain the terms parent cell and daughter cell. Ask the class for the number of chromosomes found in the daughter cells of human. Challenge the class to describe how the chromosome number in the daughter cell can be the same as in the parent cell.

5. Briefly explain to the class the importance of replication in maintaining the proper chromosome number in each body cell.

6. Tell the students that replication is a part of the first stage of cell division, scientifically referred to as mitosis. Explain to the class that mitosis is a complex process. Although it is a continuous process, biologists have divided it into five stages based upon processes observed within the cell under an optical microscope.

7. At this time explain to the students that with the aid of computers you are about to help them obtain a better understanding of the role of chromosomes in cell division (mitosis).

8. Remind the students of the basic procedures of computer operation.

9. The program commences with the software logo and then automatically proceeds to a menu. Instruct the students to press the #3 key on the keyboard to enter the section of the program: Chromosomes in Cell Division. Allow the students 10-15 minutes to operate and explore the program.

10. At the conclusion of this section, a message will be displayed that says, "END - Do you wish to continue this study or end the lesson for today?" Tell the students to stop.

11. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Do all organisms have the same number of chromosomes?
2. How many chromosomes do humans have?
3. Explain the functions of chromosomes.
4. What are homologous chromosomes?
5. Describe the process of replication.

Homework:

1. Complete the worksheet associated with this lesson.

Enrichment:

1. Are humans the only species that has 46 chromosomes? If not, which other species have 46 chromosomes?

2. Down's syndrome is a birth defect cause by an incorrect chromosomal number. Write an essay explaining the cause of Down's syndrome.

3. Is there any relationship between the number of chromosomes a given species possesses and its intelligence or size?

WORKSHEET — Chromosomes and Mitosis

Name ______________________ Class ________ Date _________

Part I - Fill in the chart below.

ORGANISM	VERTEBRATE Y/N	HABITAT	# OF CHROMOSOMES
CAT			
DOG			
HUMAN			
SHRIMP			
FROG			
FRUIT FLY			

Part II - Completion questions

1 Chromosomes are found in the __________ of cells.

2. Chromosomes carry information about ___________ and ___________ to each cell.

3. Chromosomes are always found in ________.

4. The information for hundreds of ____________ is found on each chromosome.

5. A pair of chromosomes that contain information about the same traits is said to be ________________.

6. During cell division _________ cells give rise to ______________ cells.

7. ________________ is the process in which the chromosomes divide.

8. In each succeeding generation, the chromosome number is always __________________.

9. ______________ refers to the division of the cell (nucleus).

10. Human body cells have _______ pairs of chromosomes.

TOPIC 73
Stages of Mitosis

Aim: What are the stages of mitosis?

Performance Objectives: The students will be able to:

- name the five stages of mitosis
- name and describe the parts of the cell involved in mitosis
- describe the processes that occur in each of the five stages of mitosis
- state that the chromosomes are made of DNA

Materials:

- IBM computer lab using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Cell Growth and Mitosis by Classroom Consortia Media Inc.
- chart or model showing mitosis
- worksheets

Do Now:

What happens when a cell replicates?

Motivation:

Review the concept of replication with the students. Then challenge the class to explain how each of the daughter cells receives the correct number of chromosomes when the cell divides.

Development:

1. Elicit from the students several answers to the motivational question. Guide the class to understand that the process of cell division is an involved process.

2. Show the students the mitosis chart. Call upon several students to come up and identify as many of the cell structures as they are able. Since many students will not be able to identify many of the specialized organelles associated with mitosis, write the names of these organs on the board.

3. The section of the computer program explaining mitosis is fairly long (minimum of 30 minutes) and detailed. If the students have difficulty with some of the names or concepts, the program will reintroduce several key concepts to the students. It would be advantageous to briefly introduce the stages of mitosis to the students and then let the computer program supply the details.

4. At this time explain to the students that with the aid of computers you are about to help them obtain an understanding of the process of mitosis.

5. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up (load). This software package is self-loading. The program commences with the Classroom Consortia Media logo and then automatically proceeds to a screen identifying the program. In a few moments the menu to this program is revealed. Instruct the students to press the #4 key on top of the keyboard to enter the section of the program concerned with the stages of mitosis.

6. Allow the students a reasonable amount of time to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you wish to continue this study or end the lesson for today?" Tell the students to terminate the computer activity at this point.

7. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. What are the five stages of mitosis?
2. Describe each of the five stages of mitosis.
3. Name the parts of the cell associated with mitosis.
4. What is a chromosome composed of?

Homework:

1. Complete the worksheets associated with this lesson.

Enrichment:

1. How does mitosis in animal cells differs from mitosis in plant cells?

2. What is the difference between mitosis and meiosis?

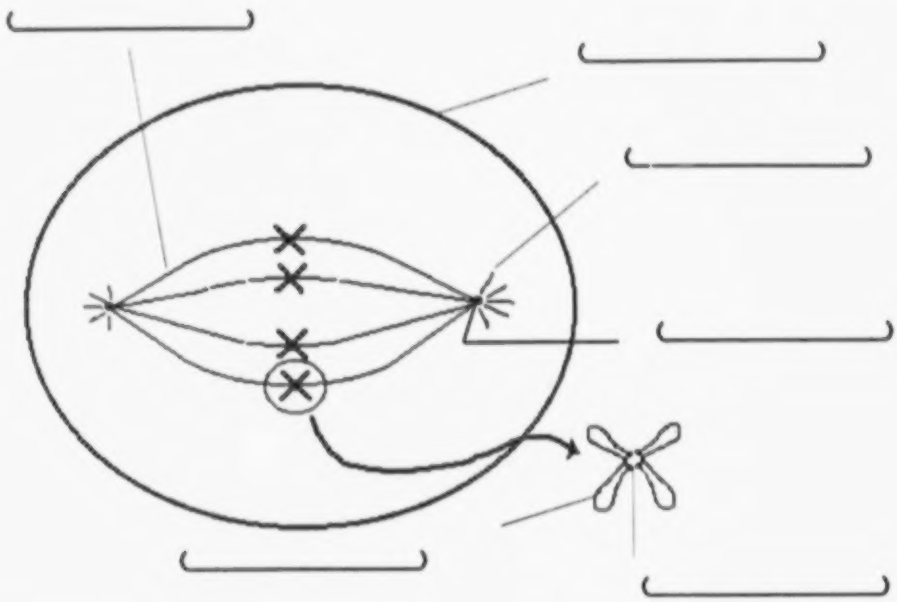
3. Do all of the cells in the human body reproduce through the process of mitosis?

4. If you look in science books written before the sixties, the books will say that humans had 48 chromosomes. Why do the books make such a claim?

WORKSHEET 1 — Stages of Mitosis

Name ______________________ **Class** _______ **Date** ________

Part I - Below is a drawing of a typical cell during mitosis. Label all of the organelles.



Part II - Completion questions

1. The nucleus is surrounded by a ______________ membrane.

2. The __________________ is involved in the manufacture of protein.

3. The cell membrane is constructed of protein, lipids and ________________________.

4. The _________________ cells are identical copies of the parent cell.

5. __________________ is the process responsible for producing billions of human body cells.

6. The first phase of mitosis is ______________.

7. Mitosis in plant cell differs from mitosis in animal cells in that in plants a ____________________ forms between the daughter cells.

8. During replication, before the chromosomes separate, each part is referred to as a ______________.

9. In a human cell, during the telophase stage, there are _____ chromosomes in the cell.

WORKSHEET 2 — Stages of Mitosis

Name ________________________ **Class** ________ **Date** _________

Part I - In the space provided below, draw the five stages of mitosis.

interphase prophase metaphase

anaphase telophase

Part II - Completion question.

1. During ______________ , the chromosomes line up at the equatorial plane.
2. During ______________ , the nuclear membrane begins to dissolve.
3. During ______________ , the cell membrane pinches to form two daughter cells.
4. During ______________ , the chromosomes replicate.
5. During ______________ , the chromosomes begin to move to opposite ends of the cell.
6. During ______________ , the nucleolus begins to dissolve.
7. During ______________ , the spindle fibers form.
8. During ______________ , the astral rays form.
9. During ______________ , the chromatids split.
10. During ______________ , the chromosomes become shorter and thicker.

TOPIC 74
Monohybrid Crosses — Facts About Genetics

Aim: What is a monohybrid cross?

Performance Objectives: The students will be able to:

- define and understand simple genetic concepts
- simulate and gather data from experimental monohybrid crosses using the Punnett Square technique
- simulate and gather data from several monohybrid crosses using a computer simulation program.

Materials:

- microcomputer laboratory with MS-DOS machines
- software: Monocross - A Monohybrid Cross Simulation by Diversified Educational Enterprises, Inc.
- copies of the Student Laboratory Guide
- copies of the Vocabulary List attached

Do Now:

What is a dominant trait? A recessive trait? What happens when a cross is performed between a pure dominant and a pure recessive trait? Why?

Motivation:

Distribute copies of the Vocabulary list which appears on page 5 of the software documentation along with the additional vocabulary words on the worksheet associated with this lesson to the class.

These terms are prerequisite for understanding the simulation that follows. Have the class review the vocabulary by silently reading the list. After a short but reasonable time ask the class if any of the terms need clarification. Discuss and explain those terms. If time permits discuss and explain terms selected by the teacher that would increase comprehension of the simulation to follow.

Development:

1. Have each student copy and solve this monohybrid cross problem using the Punnett Square technique.

   Determine the results of the following monohybrid cross with respect to the characteristic of "NERDNESS".

   N x n and N x n

   Genotypes: 1:2:1

   Phenotypes: 3:1

	N	n
N	N N	N n
n	N n	n n

2. Ask "How can we use the microcomputer to increase our understanding of large amounts of data collected from repetitive scientific tests and trials?

   Explain that in genetics research computers can simulate the cross-breeding of many generations of organisms in a short period of time. The conditions and assumptions under which these simulations are produced are easily controlled by the user of the simulation program. The simulation can be repeated rapidly and the conditions can be varied to evoke new data. The computer can also collect the data, process it, and produce reports on the data that show important relationships.

3. Distribute the Student Laboratory Guides. The class will read pages 3, 4 and the top half of page 5.

4. It is suggested that students work in pairs and that some time be spent away from the computers in order to discuss the findings revealed by the simulated crosses.

5. Distribute the "Monocross" software and have the students load the program into the computer. Start the program and have the class pick menu item # 1.

6. Have the class proceed with the simulation until the conclusion of TASK #1. Make sure each student is using the student guide properly. Insist that the data for each trial be recorded consistent with the instructions provided with the program. It is important to note that the simulation should be repeated until comprehension takes place. The time on task will vary with each group.

7. Collect all software and shut off all of the computers at the conclusion of Task #1. Point out that the simulation will be continued during the next session, but that at this time it will be necessary to interpret the results of the current set of trials.

8. Make a large summary chart on the board that shows the correct answers for the chart on page 5 of the student guide.

9. Review the Student Laboratory Guide for the answers found on Page 5 and have students correct their own work. Tell the class to save all notes because the data will be used as part of the next lab session. Explain that the numbers produced by the simulation are consistent with certain "laws of genetics" that will be studied in subsequent lessons.

10. Review the answers to the questions found just below the summary chart located in the center of page 5.

Summary:

1. What is the definition of the term "genetics"?
2. What is a genetic "cross"?
3. What is a "monohybrid cross"?
4. What term is used to describe the genetic characteristics for the way an organism appears?

5. What term is used for the actual genetic structure that an organism is born with?
6. What is the Punnett Square technique and what is it used for?
7. What kind of mathematical relationships are found after successful experiments on genetic crosses are completed? Explain.
8. Why is it helpful to use the computer for the simulation of genetic crosses in particular, and as a tool for scientific fact gathering in general?

   (The use of the computer to simulate monohybrid crosses in great numbers in a short period of time makes it more practical to study genetics first-hand.)

Homework:

1. Using the Punnett Square technique, produce monohybrid cross results for this combination of parents for the characteristic of "Nerdness": NN and Nn. Make a table to record the data.

2. Using the Punnett Square technique, produce monohybrid cross results for this combination of parents for the characteristic of "Nerdness": nn and NN. Make a table to record the data.

Enrichment:

1. Produce Punnett squares for monohybrid crosses for any of several combinations of traits.

2. Write a report on the work of Gregor Mendel. Include the role of mathematics in his investigation of inheritance.

Name ____________________ Class _____________ Date ________

Additional Vocabulary

1) dominant -- the gene that provides the material for the characteristic that is actually expressed by the organism.

2) recessive -- the gene that provides genetic material to the organism for reproduction of the species but which is not expressed as a characteristic, having been dominated by its partner, a dominant gene.

3) Punnett Square technique -- a method of predicting the genotype and phenotype ratios of certain genetic crosses.

4) genes -- biochemical compounds (DNA) that determine the heredity of an organism. Genes are parts of chromosomes.

5) cross -- an attempt to determine the characteristics and breeding traits of a organism. Crosses can be accomplished with actual organisms or through other means including the Punnett Square technique and computer simulations.

6) simulation -- a reproduction of an actual event or experiment that provides an analogous experience or result.

7) test cross -- a backcross, a test to determine the genotype of an unknown individual/organism. The test is carried out by crossing a fully recessive with the unknown. The test determines if the individual is heterozygous or homozygous with respect to the characteristic.

8) genetics -- the branch of the life sciences that studies heredity and variation of genetic material.

9) segregation -- the ability of genetic material to separate into parental patterns so that recombination can take place during reproduction thereby restoring the right count to the genetic makeup of the offspring. (This is Mendel's First Principle.)

10) phenotype ratio -- the mathematical relationship that is found as a result of a cross, when the appearance of all of the offspring with respect to a certain characteristic, are counted and compared.

11) genotype ratio -- the mathematical relationship that is found as the result of a cross, when the actual genetic makeup of all offspring is considered with respect to a certain characteristic, are counted and compared.

12) monohybrid cross -- a genetic combination that involves only one trait, a cross between parents that differ in only one trait. The possible monohybrid crosses include:

1) AA x aa
2) Aa x Aa
3) Aa x AA
4) Aa x aa

In addition, there exists the possibility of the following crosses but they do not show evidence of genetic segregation.

5) AA x AA
6) aa x aa

13) allele -- one part of a pair; of genes in relation to the effect of the gene, i.e., the dominant or recessive partner.

TOPIC 75
Monohybrid Crosses — Genotypes/Phenotypes

Aim: How can we predict the genotypes and phenotypes of organisms involving large numbers of monohybrid crosses?

Performance Objectives: The students will be able to:

- identify the genotype of one or both parents
- identify the dominant or recessive involved
- identify and explain incomplete dominance
- identify and explain phenotype ratios
- identify and explain genotype ratios.

Materials:

- laboratory with MS-DOS machines
- software: Monocross - A Monohybrid Cross Simulation by Diversified Educational Enterprises, Inc.
- copies of the Student Laboratory Guide
- copies of the Vocabulary List Attached
- pen and paper.

Do Now:

On the board, challenge the class to write with:

WRITE something quickly, using 33 WORDS or less,
"TWO REASONS FOR USING THE COMPUTER AS A GENETICS TOOL."

Motivation:

Ask the class to read as many of the Do Now exercises as time permits. Determine patterns in the answers. Point out references made about a computer's dual capabilities of 1) presenting realistic, repetitive events in simulation and 2) the simultaneous management of the data presented by the simulation.

Care should be taken to point out that these are only two of a computer's many functions. The application of these functions is especially well suited for genetics.

Development:

1. Ask the class to produce the Vocabulary list for genetics. Distribute copies to those without the list. Discuss terms that are still unfamiliar. Review others.

2. Distribute the Student Laboratory Guide. Tell the class to silently read or review the material on pages 5 - 8 so that everyone understands what is expected at the conclusion of this session.

3. Distribute the "MONOCROSS" software. With students working in pairs, load the software, and have everyone pick menu item option "1".

4. Instruct the class to repeat the simulations as often as necessary until comprehension occurs. Students should be prepared to take notes on their progress. Insist that data be collected and organized properly.

   It is suggested that the teacher prepare to let the following part of the lesson run much longer than anticipated. The amount of work, working conditions, the level of preparation, timing, the school schedule, class size and ability level, teacher understanding, and other critical factors could seriously alter the length of this unit with respect to delivery and comprehension.

5. Instruct the class to proceed with "TASK #2". Students should pause from time to time in order to complete the appropriate task worksheet in the student guide.

6. Have the class proceed with "TASK #3". Students should pause from time to time in order to complete the appropriate task worksheet in the student guide.

7. Have the class proceed with "TASK #4". Students should pause from time to time in order to complete the appropriate task worksheet in the student guide.

8. Remove the software and put it away. Turn off each computer as soon as each group finishes.

9. During the following review and summation, guide the class to the notion that the analysis and interpretation of the data gathered in the monohybrid cross simulations is a critical step in understanding genetics. Review the questions and the worksheets that accompany the tasks.

10. Tell the class that the next laboratory session will include more complex genetics simulations and that a test will be given at the conclusion of that session.

Summary:

1. How can we simulate monohybrid crosses that identify the phenotype and genotype of unknown parents?
2. How do we determine the recessiveness or dominance of genes in offspring?
3. Name two methods that can be used to show incomplete dominance in a cross for flower color in Four O'clocks
4. What do the numbers in the ratios for phenotypes actually represent? What do the numbers in the rations for genotype actually represent?
5. What kinds of problems can be solved using genetic monohybrid cross techniques?

Homework:

1. Read Pages 9-10 from the software lab manual for the next lab.
2. Bring the completed Student Laboratory Guide to the next class. It will be collected and marked after the tasks have been accomplished.
3. Study the entire genetics Student Laboratory Guide.
4. Read and review appropriate sections on genetics in the textbook.

Enrichment:

1. Research and report on Dihybrid Crosses.
2. Research and report on Statistical Analysis.
3. Write a report based on current events that describes the state of genetics research and highlight some of the critical issues in the field.
4. Using reference materials available in libraries, find information regarding academic programs for students of genetics, that are occurring in colleges and universities.
5. Research and report on the job market for genetics professionals. Include long range trends.

TOPIC 76
Monohybrid Crosses — Unknown and Hybrid Parents

Aim: What can we determine from monohybrid crosses involving hybrid parents and unknown parents?

Performance Objectives: The students will be able to:

- identify the genotype of one or both hybrid or unknown parents
- identify the dominant or recessive involved in student-created simulations of crosses
- predict and confirm expected results of crosses
- identify and explain phenotype ratios
- identify and explain genotype ratios.

Materials:

- laboratory with MS-DOS machines
- software: Monocross - A Monohybrid Cross Simulation by Diversified Educational Enterprises, Inc.
- copies of the Student Laboratory Guide
- copies of the vocabulary list attached
- copies of the "MONOCROSS" test.
- pen and paper.

Do Now:

Ask the class to write a short paragraph based upon the following:

"Are the techniques of genetic engineering (human intervention in the gene structure of living matter) real science or science fiction?"

Motivation:

Review student responses to the "Do Now" and provide examples of current applications of "genetic engineering."

Development:

1. Ask the class to discuss the ability of a geneticist to predict the outcomes of various kinds of genetic crosses, man-made, simulated, or natural. What factors are used in making these predictions.

2. Inform the class that, although the work that is being done in this room is not as complex as the work of genetics engineers, those scientists, just like this class, use computers to speed up their work. By using computer simulations to produce simulated offspring they can accurately predict results and the computer as a record-keeping tool manages the data that is produced.

3. Each member of the class should have the vocabulary list, the Student Laboratory Guide, a pen and note paper. Prepare the students to work in pairs. If anyone is unprepared, provide the required material.

4. Inform the class that this session will cover Part B and Part C which are found on pages 9 and 10 of the Student Lab Guide. Tell the class to read the material.

5. Distribute the "Monocross" software. Have students load the software and pick menu item #2.

6. Instruct the class to proceed with Part B. Students will take very careful notes. It is expected that students will pause from time to time to consider their findings and that the time on task will vary with each group.

7. Tell the students to proceed with Part C by asking for menu option #3. The students should take very careful notes. It is expected that students will pause from time to time to consider their findings and that the time on task will vary with each group.

8. If time permits, allow those who finish early to do the additional activity at the bottom of page 10.

9. Collect all of the software and turn off all of the computers.

10. Go over the work covered and review the answers to the questions presented in Part C and Part D.

11. Inform the class that a test is about to be given. Permit the class to review the vocabulary list, the student lab guide, all class notes and all text assignments, for a short but reasonable time.

12. Collect the Student Guides and evaluate them later.

13. Make sure that testing conditions prevail, i.e. proper seating, all other materials removed, no talking, pen ready, etc. Distribute and administer the test.

14. Review the test if time permits.

Summary:

1. How are genotypes of unknown parents determined?
2. How are the genotypes of hybrid parents determined?
3. How does the simulation assist in the determination of dominant and recessive genes? Can this be changed?
4. How do the results of a cross using a Punnett Square compare to the results of a cross done by computer?
5. Why is it essential to understand the ratios that are expected as a result of genetic crosses? Why may actual results differ from expected outcomes?

Homework:

1. What is sex linkage? Describe and explain.
2. What is DNA and how can we understand it?

3. What is meiosis?
4. What is mitosis?
5. What kind of environmental problems can lead to chromosomal (genetic) damage in humans?
6. Using the F1 results of a heterozygous cross, use the genotypes to produce an F2 generation. Determine phenotype and genotype ratios.

Enrichment:

Ask the class to speculate on the following:

"Where does the study of genetics fit into the real world? Why is genetics important? What about the future? Is it possible for scientists to invent a life form in the laboratory that could succeed so well on Earth that it could become a threat to mankind as the dominant species on the planet (if indeed we are the dominant species)? Will it be possible to improve the human species with genetic engineering? What are the moral implications of genetic research in humans? What will genetic engineering do to evolutionary processes and how may nature counterbalance the disturbance?"

Discuss these issues in class or have students do independent study, panels, reports, charts, time lines or other projects.

TOPIC 77
The Laws of Dominance and Segregation

Aim: What are the laws of dominance and segregation?

Performance Objectives: The students will be able to:

- name several traits of pea plants that were studied by Mendel
- define the term contrasting traits and gives several examples
- explain the concept of breeding true
- explain the concept of a hybrid individual
- explain the use of P, F1, and F2 to indicate different generations
- explain the Law of Dominance
- Explain the Law of Segregation
- use the Law of Dominance to predict the resulting F1 generation
- use the Law of Segregation to predict the resulting F1 and F2 generations

Materials:

- IBM computer lab. using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Mendelian genetics - Published by IBM
- worksheet associated with this lesson

Do Now:

How do you recognize your friends or members of your family?

Motivation:

Ask the class which characteristics they use to distinguish one human from another. Review student responses to the "Do Now."

Development:

1. On the board, write down several of the student responses to your motivational question. Tell the students that these distinguishing characteristics are what scientists call traits.

2. Challenge the class to draw up a list of traits that they can use to distinguish one dog from another. Review the answers. Point out to the students that most of these are contrasting traits. Point out that many of the human traits that were listed are also contrasting traits. Ask the class if plants have traits.

3. Again explore the answers given by the class. At this point, briefly relate the story of Gregor Mendel and his work with the pea plants.

4. At this time explain to the students that with the aid of computers you are about to teach them how they can make certain predictions as to the appearance of traits in future generations.

5. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to load.

6. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a screen identifying the program. In a few moments the menu to this program is revealed. Instruct the students to press the #1 key on top of the keyboard to enter the section of the program: Laws of Dominance and Segregation.

7. Allow the students 15-20 minutes to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point.

8. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. Define the term trait.
2. How do geneticists use P, F1 and F2 to describe the various generations?
3. What are contrasting traits?
4. Which contrasting traits did Mendel study in pea plants?
5. Explain the Law of Dominance.
6. How can we recognize a dominant trait? A recessive trait?
7. Explain the Law of Segregation.
8. What does the term pure breed mean to a geneticist?

Homework:

1. Complete the worksheet associated with this lesson.

Enrichment:

1. Make a chart showing contrasting traits in humans.

2. Name 10 dominant human traits. Which if any of these traits do you have?

3. Research modern plant genetics. What methods do geneticists use to guarantee that plants will breed true?

4. What is a pedigree?

5. Ask your parents or grandparents to help you make a family pedigree diagram showing how several traits have been passed down to various members of your family, e.g. eye color, type of earlobe.

WORKSHEET — The Laws of Dominance and Segregation

Name ________________________ **Class** ________ **Date** ________

Part I - Completion Questions

1. Mendel studied the traits of the ________plant which has the scientific name of ___________________.
2. Two contrasting traits of this plant are _____________ and _____________ flower color.
3. Two additional contrasting traits studied by Mendel are _______________ and _______________ stems.
4. In a pea plant, a ___________ seed is the dominant seed shape.
5. In a pea plant, a _____________ flower is the recessive flower color.
6. The P generation gives rise to the ______ generation which gives rise to the _____ generation.
7. When two contrasting pure traits are breed, the result is a _________.
8. The F2 generation of the above cross will result in a generation that displays both _______________ and __________________ traits.
9. _______________ is an example of a human trait.

Part II: Answer the following questions.

1. Describe the F1 and F2 generations that will arise when a pea plant which is pure for tall stems is crossed with a pea plant that is pure for short stem.

TOPIC 78
Chromosomal Theory

Aim: What is the Chromosomal Theory?

Performance Objectives: The students will be able to:

- define the term gene
- describe a chromosome
- define genotype and phenotype
- use correct terminology to indicate dominant and recessive genes.
- define the term allele
- use notations to describe several alleles
- explain the various stages of meiosis
- define the tern monoploid (haploid)
- define the tern diploid
- use Punnett squares to predict resulting genotypes and phenotypes

Materials:

- IBM computer lab. using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Mendelian Genetics published by IBM
- worksheet associated with this lesson

Do Now:

Make a list of the traits that you seem to have inherited from your father or mother.

Motivation:

Ask the class if they can explain how human traits are inherited?

Development:

1. Explain to the class that characteristics are often inherited in an orderly fashion. By closely and laboriously studying pea plants, Mendel was able to develop theories that explained how traits are inherited. Scientists using modern technology have been able to confirm Mendel's theories. They have determined that cell structures called chromosomes and the genes located on them play a vital role in determining traits.

2. Tell the class that most traits are controlled by just two genes. As the students learned in the previous lesson, some traits are dominant and some traits are recessive. Some genes for each trait are dominant and some genes for each trait a recessive. Depending on which genes you inherit from your parents, one from your mother and one from your father, you will develop a certain phenotype (physical appearance).

3. At this time explain to the students that with the aid of computers you will teach them about the terminology geneticists use. They will also learn how traits are passed on from one generation to the next. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software by telling the students not to bend the diskettes and not to put their fingers on the cut-out window of the disk.

4. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a menu. Instruct the students to press the #2 key on top of the keyboard to enter the section of the program: Chromosomal Theory. Allow the students 10-15 minutes to operate and explore the program.

5. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. What is a gene?
2. Describe a chromosome.
3. Where are genes located?
4. What is an allele?
5. Name two dominant alleles.
6. Describe the difference between monoploid and diploid.
7. Describe the various stages of meiosis.
8. Demonstrate how coins can be used to illustrate several of the principles of genetics.
9. Demonstrate how Punnett squares are used to predict genotypes and phenotypes.

Homework:

1. Complete the worksheet associated with this lesson.

Enrichment:

1. Make a Punnett square showing the cross between pure short (tt) and pure tall (TT) pea plants.

2. Make a Punnett square showing the cross between two hybrid tall pea plants. (Tt x Tt)

3. B = brown eye color allele; b = blue eye color allele. Make a Punnett square showing the cross between a person with blue eyes and a person who is hybrid for brown eyes. Make a Punnett square showing the cross between two people that are both hybrid for brown eye color.

WORKSHEET — Chromosomal Theory

Name ________________________ **Class** ________ **Date** _________

Part I - Completion Questions

1. _________ genes control one contrasting trait.

2. Genes are located at various loci of the _______________.

3. _____________ are a pair of genes for contrasting traits.

4. ______________ letters are used to represent recessive alleles.

5. Body cells contain the ______________ number of chromosomes.

6. _________ and _________ contain the monoploid number of chromosomes.

7. The word homozygous means that the alleles are ________________

8. The word heterozygous means that the alleles are ________________

9. Anaphase occurs during the process of _______________

10. ______________ refers to the genetic make-up of an individual.

11. The _____________________________ is a diagram that aids in the understanding of how genes are distributed during a cross.

Part II: Answer the following questions.

1. Draw the Punnett square that will show the F1 and F2 generations resulting from a cross between a pure short pea plant and a pure tall pea plant. Identify the resulting phenotypes by appearance and percentage in each generation.

TOPIC 79
Dyhybrids

Aim: What are the results when dihybrids are crossed?

Performance Objectives: The students will be able to:

- define the term dihybrid
- state the Law of Independent Assortment
- describe the formation of the gametes in dihybrids
- state that a phenotype ratio of 9:3:3:1 occurs in the F2 generation when homozygous dihybrids are crossed
- complete the Punnett square showing the results when dihybrids are crossed
- give examples of organisms in which the results of dihybrid crosses can be observed

Materials:

- IBM computer lab using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Mendelian Genetics published by IBM
- worksheets associated with this lesson
- chart showing a dihybrid cross

Do Now:

Remind the class that they already know the details of crosses involving one trait. Ask the class to determine the results of a crossing involving pea plant that differ in two traits; seed shape and seed color. The cross will be

RRYY x rryy

Motivation:

Display the chart. Compare the student responses to the actual results of the cross.

Development:

1. Explore various answers to the motivational question. Explain that the Punnett square can be used to to show the genotypes and phenotypes of both the F1 and F2 generations. Instead of placing 2 genes in each box, 4 genes will be placed.

2. At this time explain to the students that with the aid of computers you are going to teach them about dihybrid crosses. They will learn about the gametes which are formed and about the possible resulting fertilizations.

3. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up (load).

4. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to the menu for the program. Instruct the students to press the #3 key on top of the keyboard to enter the section of the program Patterns of Inheritance. Allow the students a reasonable amount of time to operate and explore the program.

5. The students should not proceed past the point where the program begins to discuss codominance. This is the second half of this section, but is really a separate topic that will be covered in a future lesson.

Summary:

1. What is the definition of a dihybrid?
2. What phenotype ratio is observed when dihybrids are crossed?
3. What are the genotypes observed when dihybrids are crossed?
4. In which organisms can we observe the results of dihybrid crosses?
5. Which traits can be studied in these organisms?

Homework:

1. Complete the worksheets associated with this lesson.

Enrichment:

1. Draw a Punnett square diagram showing the possible gametes formed when TTYY is crossed with ttyy. (T = tallness Y = yellow seeded)

2. What other organisms do geneticists use to study dihybrid crosses?

WORKSHEET 1 — Dihybrid Crossings

Name ______________________ **Class** ________ **Date** _________

Complete the Punnett square for the following cross. This crossing involves a pea plant.

RRYY x rryy R = round seed r = wrinkled seed
Y = yellow seed y = green seed

	________	________	________	________
________				
________				
________				
________				

_____ percent of the offspring are round yellow

_____ percent of the offspring are round green

_____ percent of the offspring are wrinkled yellow

_____ percent of the offspring are wrinkled green

WORKSHEET 2 — Dihybrid Crossings

Name ________________________ **Class** ________ **Date** ________

Complete the Punnett square for the following cross. This cross represents the F2 generation.

RrYy x RrYy R = round seed r = wrinkled seed
Y = yellow seed y = green seed

	________	________	________	________
________				
________				
________				
________				

_____ percent of the offspring are round yellow

_____ percent of the offspring are round green

_____ percent of the offspring are wrinkled yellow

_____ percent of the offspring are wrinkled green

TOPIC 80
Codominance

Aim: What is incomplete dominance (codominance)?

Performance Objectives: The students will be able to:

- define the term codominance
- describe the genotype and phenotype of the F1 generation when pure red snapdragons are crossed with pure white snapdragons
- describe the genotype and phenotype of the F2 generation resulting from the above cross.
- state that in the F2 generation the resulting phenotypes and genotypes appear in a ratio of 1:2:1
- demonstrate their ability to use the Punnett square to determine the genotypes and phenotypes which result when codominance is involved

Materials:

- IBM computer lab using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Mendelian Genetics published by IBM
- worksheets associated with this lesson
- chart showing incomplete dominance

Do Now:

Introduce the students to the four o'clock plant. What result do you expect if a red four o'clock plant is crossed with a white four o'clock?

Motivation:

Tell the class that there are organisms with certain traits that do not follow the law of complete dominance. Challenge the class to determine the phenotype of the F1 generation when a homozygous red snapdragon is crossed with a homozygous white.

RR x WW

Development:

1. Explore the student answers to the motivational question. Then explain to the class that the actual results could not be accurately forecast without actually performing the cross.

2. Explain to the class that in snapdragons, common flowers, the color of the flower follows the laws of codominance. The parental phenotype is not found in the F1 generation, rather, the F1 phenotype is intermediate to the two parental phenotypes.

3. On the board, fill in the Punnett square for the cross RR x WW. Tell the class that individuals with RW genes are pink in color, a color which is between red and white.

4. At this time explain to the students that with the aid of computers you are going to help them learn more about the law of incomplete dominance, also known as codominance.

5. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software by telling the students not to bend the diskettes and not to put their fingers on the cut-out window of the disk.

6. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a screen identifying the program. In a few moments the menu to this program is revealed. Instruct the students to press the #3 key on top of the keyboard and then to press the ENTER key once. The words DIYHBRID INHERITANCE will appear on top of the screen. At this point, instruct the students to press the PgDn key 5 times (slowly, allowing the screen to change before pressing the key again). After this is done, the word CODOMINANCE will appear on top of the screen. This is the section the class should be working with.

7. Allow the students 15-20 minutes to operate and explore the program. The computer program is of a tutorial nature and is highlighted by many outstanding illustrations. The students will be quizzed at several points during the progress of this program. If students do not respond correctly to the questions, the program will supply hints to aid the students. If the students requires more than two tries to answer a question, the program will supply the answer. At pivotal points of the program, the students will be offered an opportunity to repeat a section of the program if too many incorrect responses are detected.

8. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point. After this message, the software goes on to discuss material not covered in this lesson.

Summary:

1. Define the term codominance.
2. What is incomplete dominance?
3. Explain the results observed in the F1 generation when a snapdragon with the genes RR is crossed with a snapdragon having WW genes.
4. Describe and explain the genotype and phenotype that will be observed in the F2 generation.
5. What is the expected phenotype ratio?
6. What is the expected genotype ratio?

Homework:

1. Complete the worksheets associated with this lesson.

Enrichment:

1. The inheritance of blood types in humans is a result of codominance and multiple alleles. Research the inheritance of blood types and write a report explaining your findings.

2. Codominance is relatively common in plants. Investigate pertinent material and make a list of plants that have codominant traits.

3. Do you think there are any other human traits that are codominant? If so, what are they? How can you discover if these are codominant traits.

WORKSHEET 1 — Codominance

Name ____________________ Class ________ Date ________

Complete the Punnett square for the following cross:
Pure red snapdragon RR and pure white WW

	______	______
______		
______		

______ % RED

______ % WHITE

______ % PINK

Complete the Punnett square to show the results of crossing the F1 generation

	______	______
______		
______		

______ % RED

______ % WHITE

______ % PINK

WORKSHEET 2 — Codominance

Name ________________________ Class ________ Date _________

Codominance is also found in Andalusian fowl. When birds that are pure for white feahers are crossed with birds that are pure for black feathers, the offspring will be 100% blue (the mixture of fine white and black feathers appears blue). Complete the Punnett squares for the F1 and F2 generations. State the percentage of the resulting phenotypes. f

	____________	____________
____________		
____________		

_______ % black

_______ % white

_______ % blue

	____________	____________
____________		
____________		

_______ % black

_______ % white

_______ % blue

TOPIC 81
Sex-Linked Traits

Aim: What are sex-linked traits

Performance Objectives: The students will be able to:

- explain what is meant by 'linked traits'
- explain the concept of X and Y chromosomes
- explain how an organism's sex is determined
- define 'sex-linked trait'
- explain why fruit flies are frequently used in genetic research
- use the Punnett square to interpret crosses involving sex-linked traits
- explain why males exhibit the effects of sex-linked traits more frequently than females
- give examples of sex-linked traits in humans

Materials:

- IBM computer lab using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Mendelian Genetics published by IBM
- worksheets associated with this lesson
- color blindness chart

Do Now:

What does it mean for a person to be color blind?

Motivation:

Demonstrate the use of the color blindness chart. How would the chart appear to a person who is color blind? Why?

Development:

1. Ask the class if anyone knows a person who is color blind. Hopefully several members of the class will know individuals who are color blind. Ask these students if the individuals are male or female. In most cases, these individuals will be male.

2. Explain to the class that color blindness is what is known as a sex-linked disease. Explain that it is called sex-linked because its cause is found on special chromosomes that help to determine the sex of the organism.

3. At this time explain to the students that with the aid of computers you are going to teach them about the sex chromosomes found in all individuals. They will also learn more about sex-linked diseases. The computer will also instruct them in using Punnett squares to analyze both the distribution of male and female offspring and the passing on of sex-linked traits. .

4. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up (load).

5. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a menu. Instruct the students to press the #4 key on top of the keyboard to enter the section of the program: Sex determination and sex-linked traits.

6. Allow the students 15-20 minutes to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point.

7. At the completion of the computer guided instructional activity, have the students remove the program diskettes from the computers. The students should then turn off the computer switches and monitors.

Summary:

1. Explain the significance of the X and Y chromosomes.
2 Explain how an individual's sex is determined.
3. Define linked trait.
4. What is a sex-linked trait?
5. Why are fruit flies frequently used in genetic experiments?
6. Explain why males exhibit the effects of sex-linked traits more frequently than do females.
7. Give some examples of sex-linked diseased in humans.
8. How is the sex of an organism determined?

Homework:

1. Complete the worksheets associated with this lesson.

Enrichment:

1. Do plants have sex chromosomes? Explain and provide examples to substantiate your answer.

2. Do all animals have sex chromosomes? If not, which animals lack these chromosomes?

3. Make a list of traits which can be studied in fruit flies.

4. What is hemophilia? How is hemophilia transmitted? What precautions must hemophiliacs take? Is hemophilia curable?

WORKSHEET 1 — Sex Chromosomes

Name ________________________ Class ________ Date _________

Part I : Complete the following cross: XX x XY

	______________	______________
______________		
______________		

____ % male

____ % female

Part II - Completion questions.

1. The two sex chromosomes are normally identified as the _____ and _____ chromosomes.
2. The ____ sex chromosome is larger than the _____ sex chromosome.
3. More genes are located on the ______ sex chromosome.
4. Males inherit all sex linked traits from ____________.
5. The scientific name for the fruit fly is _______________ __________________.
6. ____________________ and ____________________ are examples of human sex-linked diseases.
7. ____________________ is an example of a sex-linked trait in fruit flies.

WORKSHEET 2 — Sex Chromosomes

Name ______________________ Class ________ Date ________

Part I - Complete each of the following crosses given that R = red eye and r = white eye (R and r are located on the sex chromosomes):

RR x rY   rY x Rr   RY x Rr   RY x rr

	________	________
________		
________		

	________	________
________		
________		

	________	________
________		
________		

	________	________
________		
________		

TOPIC 82
Dyhybrid Crosses

Aim: What are the results when dihybrids are crossed?

Performance Objectives: Students will be able to:

- define the word dihybrid
- state the law of Independent Assortment
- describe the formation of the gametes in dihybrids
- state that a phenotype ratio of 9:3:3:1 occurs in the F2 generation when homozygous dihybrids are crossed
- complete the Punnett square showing the results when dihybrids are crossed
- give examples of organisms in which the results of dihybrid crosses can be observed

Materials:

- IBM computer lab. using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Mendelian Genetics published by IBM
- worksheets associated with this lesson
- chart showing a dihybrid cross

Do Now:

Remind the class that they already know the details of crosses involving one trait. Ask them to determine the results of a crossing involving pea pea plants that differ in two traits; seed shape and seed color. The cross will be:

RRYY x rryy

Do Now:

Display the chart. Compare the student responses to the actual results of the cross.

Development:

1. Explain that the Punnett square can be used to show the genotypes and phenotypes of both the F1 and F2 generations. Instead of placing two genes in each box, four genes will be placed
2. At this time explain to the students that with the aid of computers you are going to teach them about dihybrid crosses. They will learn about the gametes which are formed and about the possible resulting fertilizations.

3. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software. Have the students insert the program disk into the disk drive (drive A if it is a two-drive system). Tell the students to turn on the computer and monitor power and wait for the software to load.

4. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to the menu of the program. Instruct the student to press the #3 key on top of the keyboard to enter the section of the program: Patterns of Inheritence.

5. The students should not proceed past the point where the program begins to discuss codominance. This is the second half of this section, but is really a seperater topic that will be covered in a future lesson.

Summary:

1. What is the definition of a dihybrid?
2. What phenotype ratio is observed when dihybrids are crossed?
3. What are the genotypes observed when dihybrids are crossed?
4. In which organisms can we observe the results of dihybrid crosses?
5. Which traits can be studied in these organisms?

Homework:

1. Complete the worksheets associated with this lesson.

Enrichment:

1. Draw a Punnett square diagram showing the possible gametes formed when RRYY is crossed with rryy. (As described in the program)

2. What other organisms do geneticists use to study dihybrid crosses.

WORKSHEET — Codominance

Name ______________________ Class ________ Date _________

Complete the Punnett square for the following cross. This cross involves a pea plant.

RRYY x rryy R = round seed r = wrinkled seed
Y = yellow seed y = green seed

_____ percent of the offspring are round yellow

_____ percent of the offspring are round green

_____ percent of the offspring are wrinkled yellow

_____ percent of the offspring are wrinkled green

WORKSHEET — Dihybrid Cross

Name ________________________ Class ________ Date _________

Complete the Punnett square for the following cross. This cross represents the F2 generation

RrYy x RrYy R = round seed r = wrinkled seed
Y = yellow seed y = green seed

	____	____	____	____
____				
____				
____				
____				

_____ percent of the offspring are round yellow

_____ percent of the offspring are round green

_____ percent of the offspring are wrinkled yellow

_____ percent of the offspring are wrinkled green

TOPIC 83
Mutations

Aim: How do mutations cause genetic disorders?

Performance Objectives: The students will be able to:

- explain the cause and symptoms of Down's syndrome
- define nondisjunction
- describe four types of chromosomal breakage
- explain how mutations can alter enzyme production
- define phenylketonuria (PKU)

Materials:

- IBM computer lab. using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Pathology: Diseases and Defenses published by IBM
- worksheet associated with this lesson
- photographs or slides of mutated organisms or human beings

Do Now:

Ask the students to define the term mutation.

Motivation:

Display photographs or slides of mutations. Challenge the students to explain the causes of these mutations.

Development:

1. Explore the student responses to the motivation. Guide the students to understand that a mutation is a sudden change to a chromosome or gene which can alter an inherited trait.

2. Explain to the students that various agents can cause mutations. Some mutations result from exposure to radiation from X-rays, cosmic rays or radioactive isotopes. Certain chemicals have also been shown to cause mutations.

3. Challenge the students to name disorders associated with mutations. Many of the students should be able to name Down's syndrome. Guide the students to understand that this is a relatively common mutation. Individuals who have this condition are mentally retarded, have short bodies and necks, and are highly susceptible to many infectious diseases. With proper training, however, these individuals can hold jobs and lead near normal lives. Down's syndrome is caused by the body cells having an extra chromosome (47 instead of 46 chromosomes).

4. Ask the students to describe how the genes and chromosomes are altered to produce mutations. Allow students to come to the board to try to illustrate changes to the chromosomes.

5. Explain to the students that they will use the computers to obtain a fuller understanding of mutations, some disorders due to mutations and the way in which chromosomes mutate.

6. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software.

7. Have the students turn on their monitors and then insert the program disk into the disk drive. The students must then turn on the computer's power. This software package is self-loading. The program commences with a blue screen displaying the IBM logo and then proceeds to a menu. Instruct the students to press the #3 key on the keyboard to enter the section of the program: Genetic Disorders.

8. Allow the students a reasonable amount of time to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the activity at this point.

Summary:

1. What is Down's syndrome?
2. What is the cause of Down's syndrome?
3. What is nondisjunction?
4. How do mutations alter enzyme production?
5. Explain PKU.

Homework:

1. Complete the worksheet associated with this lesson.

Enrichment:

1. Make a chart comparing several chromosome alterations.

2. Write a report on chemicals which can cause mutations.

WORKSHEET — Mutations

Name ______________________ **Class** _______ **Date** ________

Part I - In the space provided below, draw a series of diagrams illustrating how the process of meiosis can produce the gamete responsible for causing Down's syndrome.

Part II - Completion questions.

1. ______________ are changes in the genetic material.

2. Changes in the genetic material often occur during the time when the ___________ are produced.

3. __________________ is the failure of the chromosomes to separate during meiosis.

4. Down's syndrome is caused by an _____________ chromosome.

5. ______________ is a type of mutation which occurs when a piece of the chromosome is lost.

6. _______________ is a type of mutation which occurs when part of the chromosome moves to another chromosome.

7. __________ contain the genetic code for enzymes.

8. PKU is caused by a missing _________.

9. PKU results in an excess amount of ______________ being present in the body.

10. PKU causes damage to the ____________ system.

TOPIC 84
Modern Heredity and Other Applications

Aim: What is the relationship between different genetic characteristics in the same organism?

Performance Objectives: The students will be able to:

- explain the significance of Mendel's law of independent assortment
- prepare a Punnett square for a dihybrid cross
- explain why some genetic characteristics appear to violate the law of independent assortment
- describe the concept of linked traits

Materials:

- MS-DOS computer lab, DOS containing BASIC language
- software: Dicross, by Diversified Educational Enterprises
- chart displaying a dihybrid cross.
- rexographed sheet of dihybrid cross Punnett square problems.

Do Now:

Define: Law of Independent Assortment, Law of Segregration, Law of Dominance, Law of Codominance

Motivation:

1. Review the concepts of Mendelian genetics by asking the students to explain what happens when a pure tall pea plant is crossed with a pure short pea plant.

   The teacher should place the key points of the student responses on the board and review the concepts of dominant and recessive as well as the vocabulary words "genotype" and "phenotype"

2. Ask the students "What will happen if a pure tall and pure yellow (dominant for both characteristics) pea plant is crossed with a pure short and pure green (recessive for both characteristics) pea plant? Review the results of this cross and introduce the term " dihybrid cross" to identify an organism that is hybrid for more than one characteristic.

3. Ask the students what will occur when a cross occurs between two dihybrid organisms. Elicit student responses and then show the students how to complete a dihybrid cross Punnett square for the dihybrid cross.

4. Show the students that the cross results in four different phenotypes in a ratio of 9:3:3:1. Explain or demonstrate that each trait is distributed independently of the others.

5. Give the students a dihybrid cross problem and allow them sufficient time to complete the activity.

Development:

1. Call upon one or more of the students to come up to the chalkboard and place their Punnett squares on the board. Review the students' work and discuss outcomes of the cross.

2. Inform the students that they will use the computers to perform a series of test crosses between organisms to see the outcome. The teacher should explain to the students that the organisms being cross-bred are fictitious organisms. The students have the option of selecting a fictitious plant or a fictitious insect. In each case the student can select two characteristics for cross-breeding.

3. Distribute the software and the DOS disks. If the students are not familiar with the operation of the computers inform them that they should not bend or fold the disks and should not place anything but the diskettes into the disk drive.

4. Instruct the students to insert the DOS disk into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. When they get the date/time prompts tell them to strike the space bar. When they get the "A" prompt, instruct them to type the word "basica". After the programming language has been loaded and the computer prompts that it is ready, tell the students to remove the DOS disk and insert the program disk. Instruct them to strike function key F3. The machine will respond with "LOAD". The students should then type the name of the program "DICROSS" and strike the enter key. After the program finishes loading it will indicate "READY". The students should then type the word run "RUN" and strike the enter key. The program will start running and provide the students with the instructions necessar operate the software and perform the experimental crosses.

5. Prior to actually performing the test crosses, the students must read the operating instructions from the software documentation. This documentation is necessary for the students to learn which of the pairs of characteristics are dominant and recessive. For example, if the students plan to perform a test cross between two specimens of the plant "Syntax delerium", the students select two characteristics from the following list:
    a) flower color
    b) leaf width
    c) leaf color
    d) leaves per group
    e) stem texture

   Each of these characteristics contains a dominant and recessive trait. For example, for flower color, the plant can have the trait for purple [P] dominant or blue [p] recessive.

   The software documentation informs the students that the computer "knows" the characteristics and linkage groups. When the students perform the test cross, they are presented with the opportunity to select the number of offspring produced. The computer will provide the students with information about the phenotypes of the resulting offspring.

6. The software appears quite simple at first glance: the tasks which are required of the students are quite complex and the students should be well-versed in completing dihybrid crosses and be aware of the ratios of offspring produced prior to operating this software. After the students receive the data concerning the offspring that they produced, they should analyze the ratios of the offspring to determine if the traits selected are sex-linked. The teacher should also be aware that the offspring produced do not always follow the idealized ratios produced by the Punnett square. As an example, if the students select to crossbreed plants that are purple and short, the outcome in the F1 generation is 9 purple/tall, 3 purple short, 5 blue tall and 1 blue short.

   TELL THE STUDENTS TO KEEP ACCURATE WRITTEN RECORDS OF THE EXPERIMENTS THAT THEY PERFORMED AND OF THE RESULTS THAT THEY OBTAINED.

7. The teacher should examine the DICROSS Test contained within this software in order to determine if it suitable for the class.

8. At the conclusion of the computer activity, instruct the students to place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers and monitors.

Summary:

1. Have the students analyze the results of their individual experiments using a Punnett square. As a result of their analysis they should be able to determine:
   a. which of the traits were linked.
   b. which traits appear to assort independently of the traits being tested.
   c. what crosses should be performed in order to confirm the linkage of specific traits.

2. At the completion of their individual analysis, call upon several of the students to report their results to the class.

Homework: Use your biology textbook to help you complete this assignment.

1. Determine the genotypes of all of the offspring which resulted from your test crosses.
2. The fruit fly, Drosophila, exhibits many characteristics which are similar to those of the fictitious "Creepus hirsutil." Write a short report on the linked traits found in Drosophila and the reasons why this insect is well suited for research projects involving the study of linked traits.

Enrichment:

1. Research and prepare a report on how hybrid fertilization has brought about the vast improvements in agricultural production known as the "green revolution."

2. Write a short report explaining how breeders use the principles of genetics to improve the characteristics of both plants and animals.

WORKSHEET — Dihybrid Cross

Name ______________________ **Class** ________ **Date** ________

What would be the results if a pea plant that is pure tall and has green seeds is crossed with a pea plant that is pure short and has yellow seeds?

1. Complete the Punnett square
2. Describe the genotypes and phenotypes of the resulting offspring.

Use T for tall
Use t for short
Use Y for yellow
Use y for green

	T Y			
T Y				

TOPIC 85
Genetic Diseases

Aim: How do malfunctions in chromosomes and genes produce genetic diseases?

Performance Objectives: Students will be able to:

- explain chromosomal changes that occur during meiosis
- draw and describe the alterations in chromosomes that result in nondisjuntion, deletion, translocation, and inversion
- list the defects caused by these chromosomal alterations
- explain the causes and symptoms of the genetic diseases Down's Syndrome and Phenylketonuria (PKU)
- describe the relationship between genes and enzymes
- explain enzyme specificity

Materials:

- IBM computer lab
- software: Pathology: Diseases and Defenses by IBM
- breakdown demonstration model of a gene and a chromosome
- overhead projector and transparencies showing normal fertilization and meiosis

Do Now:

Define mutation, Down's Syndrome, PKM

Motivation:

Demonstrate meiotic division. How many chromosomes are present in each gamete? What role does meiosis play in reproduction? In reviewing the student responses, elicit from them that each gamete contains half the normal complement of chromosomes and that meiosis prepares the egg and sperm to have the full normal number of chromosomes after fertilization.

Development:

1. Display the model of the chromosome. Demonstrate one of the malfunctions that may occur during the process of meiosis. Elicit from the class other possible malfunctions.

2. Demonstrate a gene to the class. Elicit or explain the role of the gene in controlling the formation of proteins in the body such as enzymes. Briefly review enzyme specifity as discussed in previous lessons.

3. Summarize this discussion and tell the students that the program they are about to use will teach them how malfunctions in chromosomes and genes produce genetic diseases and will allow them to interact with the computer in order to verify their comprehension of genetic diseases.

4. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

5. When the menu appears on the screen, instruct the students to select option #3 - Genetic Disorders.

6. The computer-directed instruction starts with a definition of mutations and explains under what conditions they may occur. This if followed by an animation of the process of meiosis.

7. A series of animations demonstrate what happens during nondisjunction, Down's Syndrome, and other chromosomal alterations such as deletions, translocations, and inversions. These are followed by a review and quiz.

8. The program continues with problems caused by changes in genes. The roles of genes and enzymes are explained and the genetic disease Phenylketonuria (PKU) is graphically explained. The section concludes with a six-question matching quiz.

9. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained information screen. Suggested time is 15-20 minutes. Instruct the students to stop the program at the end of the matching quiz, to remove the disk from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers carefully without touching the recording surface.

Summary:

1. What changes occur in the chromosomes during meiosis?
2. What are some of the possible kinds of alterations that may occur in our chromosomes during meiosis?
3. What are the specific causes of these chromosomal alterations: nondisjuntion, deletion, translocation, and inversion?
4. How can we describe the relationship between genes and enzymes?
5. What is meant by enzyme specificity?
6. What are the causes and symptoms of the genetic diseases Down's Syndrome, and Phenylketonuria (PKU)?

Homework:

1. Assign students appropriate readings in text on genetic diseases.

2. Complete the attached chart on genetic diseases. Fill in the missing information including appropriate diagrams.

3. Define the following terms: mutation, gamete, homologous, zygote, haploid (monoploid), diploid,

4. Why is a urine test done to verify the presence of the genetic defect PKU in a person?

Enrichment:

Option 1: Research and report to the class on current genetic research such as gene splicing and its implications for either preventing or finding a cure for genetic diseases.

Option 2: Complete the following activity on your computer: Modern Genetics: Chromosomes and Coding - Section 4: Genetic Disease by IBM. Report to the class on several genetic diseases discussed in this section such as sickle cell anemia and cystic fibrosis.

WORKSHEET — Genetic Diseases

Name ______________________ Class ________ Date _________

NAME OF MALFUNCTION	GENE OR CHROMOSOME INVOLVED	CHARACTERISTIC OR DEFECT	DISEASE ASSOCIATED DEFECT
	chromosomes	uneven distribution of chromosomes during meiosis	
			one form of leukemia
translocation			
	chromosome		sterility, birth defects in offspring
defective gene			PKU

WORKSHEET — Diagrams of Defects

Name ______________________ Class ________ Date _________

1. Inversion

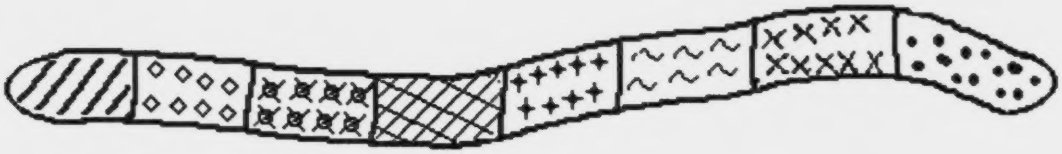
2. Translocation:

3. Deletion

4. Nondisjunction

Defective gene (PKU)

6. KEY: NORMAL CHROMOSOME



TOPIC 86
Identification and Composition of Genetic Material

Aim: What is the structure of the DNA molecule?

Performance Objectives: The students will be able to:

- identify the basic structures of the DNA molecule
- explain the process of DNA replication
- replicate a DNA molecule by selecting the proper bases
- describe the significance of the DNA double helix
- describe the formation and function of the mRNA

Materials:

- MS-DOS computer labs, DOS
- software: DNA - The Master Molecule by Educational Materials and Equipment Co.
- model or chart of the DNA double helix structure
- rexographed worksheet exercise on DNA replication

Do Now:

Why is DNA often called "the master molecule"?

Motivation:

1. The teacher should display the DNA model and introduce it as a model which displays the major structures of the DNA nucleotide. The teacher should introduce the concept of a scientific model and describe how this model was developed by Watson and Crick.

2. What difficulties were encountered in discovering the internal structure of a complex molecule?

3. Why was the development of this model a significant step in our understanding of human heredity?

Development:

1. Review student responses to the motivation and inform the students that they will use the computers to learn about the structure of the DNA molecule and the way in which this molecule can replicate or copy itself.

2. Distribute the software and the DOS disks. If the students are not familiar with the operation of the computers inform them that they should not bend or fold the disks and should not place anything but the diskettes into the disk drive. Instruct the students to insert the DOS disc into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. When they get the date/time prompts tell them to strike the space bar. When they get the "A" prompt, instruct them to remove the diskettes and insert program disk #1. They should type the word "hello".

3. The program will start running and will present the students with a title screen, followed by the menu. Instruct the students to select Part A-DNA Structure.

   a. This part of the program introduces the DNA molecule and gives the students the opportunity to build the basic structure of the DNA molecule step by step.

      TEACHERS SHOULD BE AWARE THAT THE KEYS USED TO CONTROL THE OPERATION OF THIS PROGRAM ON THE TANDY 1000 COMPUTERS DIFFER FROM THE KEYS GIVEN IN THE INSTRUCTIONS ON THE SCREEN. STUDENTS OPERATING THIS PROGRAM ON THE TANDY COMPUTERS SHOULD BE INSTRUCTED TO USE THE "4" and the "6" ON THE KEYPAD INSTEAD OF THE SYMBOLS GIVEN ON THE SCREEN. THE "6" ADVANCES THE PROGRAM TO THE NEXT SCREEN WHILE THE "4" MOVES THE PROGRAM BACK TO THE PREVIOUS SCREEN.

      This program contains advanced material and may not be suitable for all biology classes. The teacher should review the contents of the program prior to using it in class.

   b. The students assemble a diagram of a nucleotide using pairs of sugar-phosphate backbones connected together by pairs of nucleotides.

   c. The program shows the students the arrangement of the purine (adenine and guanine) and pyrimidine (cytosine and thymine) bases.

4. At the conclusion of the segment on DNA structure, the program demonstrates the transcription of mRNA and illustrates now the DNA sends its message to the cytoplasm where it directs the building of protein molecules. The students play an active part in this process by deciphering the mRNA message and identifying the triplet code.

   THE STUDENTS SHOULD BE FAMILIAR WITH THE PROCESS OF RNA TRANSCRIPTION PRIOR TO ATTEMPTING TO OPERATE THIS PROGRAM. A LIST OF THE AMINO ACID CODES, THEIR NAMES AND ABBREVIATIONS ARE AVAILABLE ON THE BACK COVER OF THE SOFTWARE DOCUMENTATION.

5. At the conclusion of the computer activity, instruct the students to place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers and monitors.

6. Distribute the worksheets and give the students time to complete the activity. Following the completion of the written exercise, the teacher should place a large drawing of the DNA nucleotide on the chalkboard or use a chart to help the students visualize the structure while reviewing the student responses.

Summary:

1. What is the significance of the DNA double helix?

2. How does the DNA molecule replicate?

3. What patterns of nucleotide bases are found in DNA?

4. How do the nucleotide bases found in mRNA differ from those in DNA?

Homework: Use your biology textbook to help you complete this assignment.

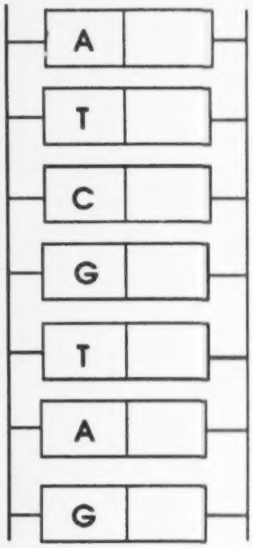
1. What are the fundamental units found in both DNA and RNA?
2. How does the sugar found in DNA differ from the sugar found in RNA?
3. How are the nitrogen bases which compose the DNA double helix joined together?

Enrichment:

Write a short paragraph describing the process of DNA replication.

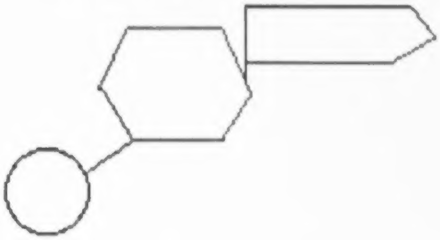
WORKSHEET — DNA Replication and mRNA Formation

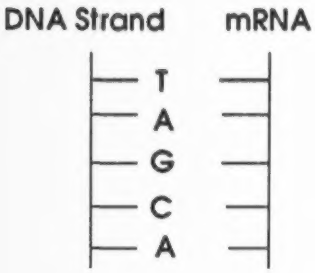
Name ________________________ Class ________ Date _________



1) Write the complementary strand of DNA

2) Label the parts of this DNA nucleotide





3) RNA transcription
Write the complementary nucleotides found in the mRNA strand

QUESTIONS

1) What is the sugar in DNA nucleotides?_______ __________________
In RNA nucleotides? ______________________________

2) How are the nucleotides attached to form the "ladder-steps" of the DNA double helix?

3) The genetic instructions carried in a strand of DNA result from its ____________

TOPIC 87
Molecular Genetics/Protein Synthesis

Aim: How does the synthesis of proteins occur in cells?

Performance Objectives: The students will be able to:

- describe the function of the ribosome.
- explain how the tRNA functions in bringing amino acids together in the correct sequences.
- describe how the tRNA codon binds to the complementary position on the mRNA.
- describe the composition of mRNA and tRNA and explain how they differ in composition from DNA

Materials:

- MS-DOS computer lab, DOS
- software: DNA-The Master Molecule, by Educational Materials and Equipment Co.
- model or chart illustrating the structure of mRNA and tRNA.
- student worksheets

Do Now:

What is the function of RNA? What are the two types of RNA? How does RNA differ from DNA?

Motivation:

1. Display the chart or model of the mRNA. How can this template form a new protein out of the amino acids which are floating around in the cytoplasm of the cell?

2. Elicit student responses and guide the students into developing an understanding that the tRNA (transfer RNA) goes out and collects the appropriate amino acid molecules and delivers them to the ribosome.

3. What insures that the tRNA delivers the correct amino acid to the appropriate site?

Development:

1. Discuss the student responses and use the model or chart to help the students develop an understanding of the function of the tRNA. At this point inform the students that they will use the computers to learn how protein synthesis occurs with the help of the mRNA which acts like a template for the synthesis of new proteins and the tRNA which delivers the amino acids in the correct sequence.

2. Distribute the software and the DOS disks. If the students are not familiar with the operation of the computers inform them that they should not bend or fold the disks and should not place anything but the diskettes into the disk drive.

3. Instruct the students to insert the DOS disk into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. When they get the date/time prompts tell them to strike the space bar. When they get the "A" prompt, instruct them to remove the diskettes and insert program disc #1. They should type the word "HELLO" and press the "enter" key. The program will load and present the students with a title screen and a menu. Instruct the students to select "Part C-Translation and Protein Synthesis."

4. Inform the students that if they are using the TANDY 1000 computers, the program cannot be controlled using the keys given in the instructions presented on the screen. When the students are ready to advance to the next screen they should press the "6" and if they wish to move backwards one screen they should depress the "4". These are the numbers located on the numeric keypad and they replace the "<" and ">" in the program instructions.

5. Allow the students a sufficient amount of time to complete all of the work included within this program. The students should be given a minimum of 20 minutes to operate this segment of the program. As the subject matter is quite complex it is suggested that the teacher circulate around the room and assist the students with any difficulties that they may experience. THIS PROGRAM MAY CONTAINS SOME ADVANCED MATERIAL AND MAY NOT BE APPROPRIATE FOR ALL BIOLOGY STUDENTS. THE TEACHER SHOULD PREVIEW THE PROGRAM AND OPERATE IT PRIOR TO USING IT IN CLASS.

6. The following topics and activities are presented to the students during the operation of the program:
   a. the function of the ribosome in protein synthesis
   b. the structure and function of the tRNA
   c. the assembly of a protein from amino acids, the students then identify the amino acid components using information presented within the program.
   d. the structure of the codon and anticodon and the way in which the amino acids are assembled in the correct sequence to build the new protein molecule.

7. At the conclusion of the computer activity, instruct the students to place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers and monitors.

Summary:

1. Distribute the worksheets and give the students the opportunity to complete the written exercise. The students may require the use of their textbooks to assist them in identifying the specific amino acids that are utilized in protein building.

Homework: Use your biology textbook to help you complete this assignment.

define each of these terms:

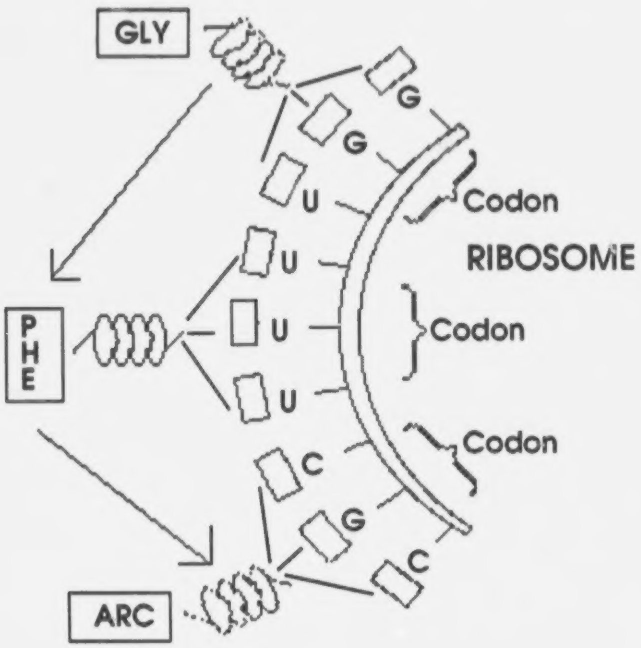
replication
hydrogen bonds
mRNA
protein
protein synthesis
amino acid
tRNA
peptide
transcription
codon
nitrogen base
polypeptide
translation
anticodon
nucleotide
ribosome

Enrichment:

How do the genetic codes for proteins in humans compare with the genetic codes in other organisms?

WORKSHEET — Protein Synthesis

Name ________________________ **Class** ________ **Date** _________



The diagram shows a segment of mRNA alongside the ribosome. The codons of the messenger RNA have been labelled to show the nucleotides they contain. Write the nucleotides of the tRNA anticodons in the spaces provided.

---

1. What is the function of mRNA?
2. What is the source of mRNA?
3. What is the function of tRNA?
4. How do the codons in mRNA differ from the complementary anticodons of the tRNA?
5. What will happen to the amino acids that are shown attached to the tRNA?

TOPIC 88
DNA Structure

Aim: What is the chemical structure of DNA?

Performance Objectives: Students will be able to:

- explain the general structure of a nucleotide
- recognize the four different nucleotides
- explain complementary base pairing
- construct a complementary DNA strand given a single DNA strand
- list the steps involved in DNA replication

Materials:

- IBM computer lab
- software: DNA The Master Molecule by Educational Materials and Equipment Co.
- chart or model showing the structure of DNA

Do Now:

How did the discovery of DNA revolutionize our understanding of inheritance?

Motivation: Place the following statement on the board:

DNA is the only non-living molecule known to man that possesses the ability to replicate itself.

What must we know if we are to understand how DNA is able to do this?

Development:

1. Display the chart or model which illustrates the structure of DNA. Ask the students to try to describe the shape of the molecule. Elicit from the students a description of the molecule, introduce the term 'double helix'.

2. Describe the three basic units of the DNA molecule, sugar phosphate and a nitrogenous base. List the four different bases and develop the concept of complementary base pairs.

3. Discuss with the students the requirements for DNA replication. Develop the idea of the double helix 'unwinding' and new base pair formation.

4. Load DOS into the computer. Insert disk 1 into drive "A" while DOS is running. Type "HELLO". Note: This program is NOT self-loading.

5. When the menu appears select option A. This section reviews DNA structure and allows the student to interact with the computer and 'build' a complementary strand of DNA. It also reviews the concept of complementary base pairs.

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6. Allow the students a reasonable amount of time to complete the activity. Suggested time is 10 minutes. Instruct the students to remove the disk when they have returned to the main menu. Note: There is no exit option on the menu. Have the students turn off the computer and the monitor. Remind students to put the diskettes into the protective covers carefully without touching the magnetic surface.

Summary:

1. What is the basic unit of DNA?
2. What are the four nitrogenous bases?
3. Which bases are the purines?
4. Which bases are the pyrimidines?
5. What is a complementary base pair?
6. What is the shape of the DNA molecule?
7. How does DNA replicate?

Homework:

Answer the following questions based on the attached worksheet.

1. What is the name of the structure in Figure 1?
2. Name the four different molecules that are represented by "B" in Figure 1.
3. How many nucleotides are there in Figure 2?
4. Draw in the complementary strand for Figure 3.

Enrichment:

1. Explain how the structure of DNA and the process of replication relates to mitosis and meiosis?

2. Relate the process of DNA replication to a particular phase of the cell cycle.

WORKSHEET —DNA

Name ______________________ Class ________ Date __________

FIGURE 1

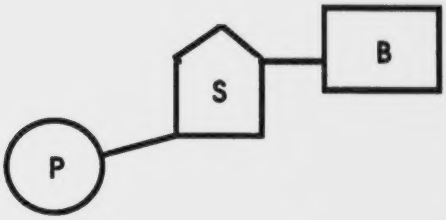


FIGURE 2

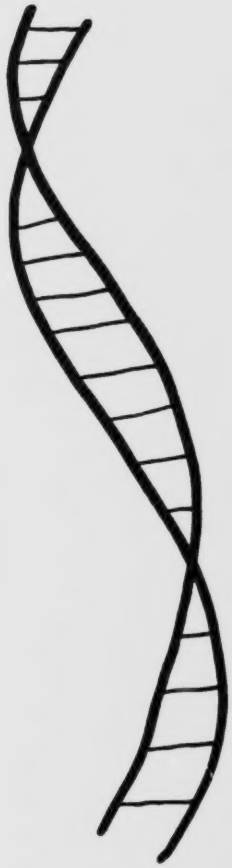
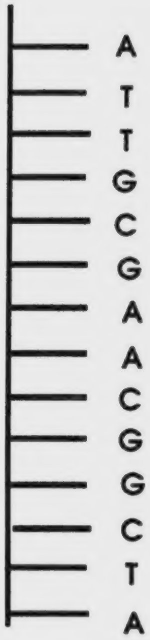


FIGURE 3


A
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TOPIC 89
mRNA Transcription

Aim: How is messenger RNA produced from DNA?

Performance Objectives: Students will be able to:

- describe the mRNA molecule
- differentiate and list the differences between DNA and mRNA
- describe the process of mRNA production
- differentiate and list the differences between DNA replication and mRNA transcription

Materials:

- IBM computer lab
- software: DNA The Master Molecule by Educational Materials and Equipment Co.
- models or classroom charts of DNA helix and RNA

Do Now: Place the following question on the board:

If DNA never leaves the nucleus, how does it control all the activities of the cell that occur in the cytoplasm?

Motivation:

> If the DNA acts like a central office, how could it communicate messages to branch offices or employees out in the field?

Development:

1. Introduce the concept of a 'messenger' molecule. Elicit from the students the requirements for such a molecule, i.e. smaller than DNA, able to leave the nucleus, etc.

2. Describe the structure of RNA. Discuss and compare it with the DNA molecule, i.e. one strand versus 2 strands, uracil instead of thymine, etc.

3. Elicit from the students the requirements for mRNA production, i.e. DNA must unwind, complementary bases must attach, etc.

4. Describe the process of mRNA production. Compare mRNA production with DNA replication.

5. Boot computer. Insert disk 1 into drive "A" while DOS is running. Type "HELLO". Note: This program is NOT self-loading.

6. When the menu appears select option B. This section reviews mRNA transcription and allows the student to interact with the computer and transcribe an mRNA molecule. It also reviews the structure of mRNA and notes the differences between mRNA and DNA.

7. Allow the students a reasonable amount of time to complete the activity. Suggested time is 10 minutes. Instruct the students to stop after the review of transcription. Note: This is in the middle of the section and there is no exit option. Instruct the students to remove the diskette and turn off the computer and the monitor. Remind the students to put the diskettes into the protective covers without touching the magnetic surface.

Summary:

1. What are the four nitrogenous bases found in mRNA?
2. How many strands are there in a molecule of mRNA?
3. What is the difference between the sugar in DNA and the sugar in RNA?
4. How is a molecule of mRNA constructed?
5. Where does the mRNA molecule go after it is constructed?

Homework:

1. List the differences between a molecule of DNA and a molecule of mRNA.
2. Describe the steps of mRNA transcription.
3. List the differences between mRNA transcription and DNA replication.
4. Define the function of mRNA.

Enrichment:

1. Construct a model of a DNA molecule and several corresponding mRNA molecules.
2. Write the autobiography of a uracil nucleotide.

TOPIC 90
Translation/Protein Synthesis

Aim: How is the message in mRNA translated into a protein?

Performance Objectives: Students will be able to:

- understand the concept of a codon
- understand the concept of an anticodon
- distinguish mRNA from tRNA
- identify the amino acid that is coded for by a codon
- explain the role of a ribosome in protein synthesis
- construct an amino acid chain from a section of mRNA
- list the steps in protein synthesis

Materials:

- IBM computer lab
- software: DNA The Master Molecule by Educational Materials and Equipment Co.
- models or diagrams of DNA, tRNA, mRNA

Do Now: Place the following question on the board:

If the purpose of the code in the DNA is to build proteins what must occur after the mRNA travels into the cytoplasm?

Motivation:

Display the RNA models. Review with the students the structure and composition of proteins. Explain the concept of the triplet code for a single amino acid.

Development:

1. Explain the function of the ribosome and the role of tRNA in protein synthesis. Elicit the steps involved in protein synthesis starting with DNA and ending with an amino acid chain.

2. Boot computer. Insert disk 1 into drive "A" while DOS is running. Type "HELLO". Note: This program in NOT self-loading.

3. When the menu appears select option B. The section will review mRNA transcription and introduce the concept of triplet codes. After finishing option B the students should continue with option C. This section will explain the role of the ribosome in protein synthesis and allow the student to interact with the computer and build an amino acid chain.

4. Allow the students a reasonable amount of time to complete the activity. Suggested time is 20 - 25 minutes. When the students finish option C they should select the QUIT option. Instruct the students to remove the diskette when they have finished. Have the students turn off the computer and the monitor. Remind the students to put the diskettes into the protective covers carefully without touching the magnetic surface.

Summary:

1. What is a codon?
2. What is an anticodon?
3. Where is the codon located?
4. Where is the anticodon located?
5. What is the function of tRNA?
6. What is the function of the ribosome?

Homework:

1. Where does protein synthesis take place?
2. List the steps in protein synthesis.
3. Compare mRNA and tRNA.
4. What is the function of 'nonsense' codons?
5. Using the attached table, diagram a section of DNA, the corresponding mRNA molecule and the protein it codes for.

Enrichment:

1. Describe the possible results of the substitution of an incorrect base in the transcription of mRNA.
2. Describe the possible results of the substitution of an incorrect base in tRNA in the translation of mRNA.
3. Describe the possible results of a tRNA molecule that picks up an incorrect amino acid.

AMINO ACIDS AND THEIR MESSENGER RNA CODONS

Alanine	GCA GCG GCC GCU
Arginine	AGA AGG CGA CGG CGC CGU
Aspartic Acid	GAC GAU
Asparagine	AAC AAU
Cysteine	UGC UGU
Glycine	GGA GGG GGC GGU
Glutamine	CAA CAG
Glutamic Acid	GAA GAG
Histidine	CAC CAU
Isoleucine	AUC AUU AUA
Lysine	AAA AAG
Leucine	CUA CUG CUC CUU UUA UUG
Methionine	AUG
Phenylanine	UUC UUU
Proline	CCA CCG CCC CCU
Serine	AGC AGU UCA UCG UCC UCU
Threonine	ACA ACG ACC ACU
Tryptophan	UGG
Tyrosine	UAC UAU
Valine	GUA GUG GUC GUU
Nonsense	UAA UAG UGA

TOPIC 91
Population Genetics

Aim: What factors influence the inherited characteristics of a population?

Performance Objectives: The students will be able to:

- formulate a prediction of the offspring that will be produced as a result of a trial mating
- test the predictions and compare the data from the test matings with the predictions
- write a genotype for each phenotype produced
- explain how sex-linked traits can affect a population
- prepare and test population models for dominance and recessiveness, partial dominance, lethality, multiple alleles, sex-linkage, crossing over and gene mapping

Materials:

- MS-DOS computer labs
- software: Advanced Genetics by Educational Materials and Equipment Company
- Advanced Genetics Study Guide, the documentation which accompanies the software

Do Now:

For a population in which mating is random, what is the expected ratio of male offspring to female offspring? Why?

Motivation:

1. According to theory, the number of male offspring produced by a family should be equal to the number of female offspring produced. Do the results observed by studying actual family data compare with the results produced when preparing a Punnett square? How do the results compare when large population samples are studied?

2. What factors, in addition to sample size, may cause deviations from the expected outcomes?

Development:

1. Discuss the student responses to the motivation questions and list the most significant responses on the chalkboard. Distribute the software documentation books and instruct the students to read page 14 "Overview of Explanatory System" to review the factors associated with population genetics and to become familiar with those factors utilized by this software.

2. At this point inform the students that they will use the computers to perform a series of experiments to determine the outcomes when matings occur between organisms in a population.

3. Instruct the students to insert the disk into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. This software is self-loading on the Tandy 1000 and IBM PC microcomputers.

4. The program starts operating by presenting the students with a title screen, followed by a series of instructions, The students should press the space bar following each instruction for the next screen to appear. As there are 19 different command codes that are used in the operation of the program, the students may wish to utilize the list of command codes presented on page 1 of the documentation to help avoid making errors.

5. When presented with the option to experiment or test, the students should select "E" (experiment). In this mode they can request a complete trait diagnosis for each problem. In this mode, the students perform laboratory experiments on organisms of known genotype and attempt to make accurate predictions of the results. In the "T" (test) mode, the students work with organisms of unknown genotype.

6. The software is divided into 11 units as listed below, The students should be familiar with the topics prior to performing this activity. In addition, the teacher should review this software to determine whether it is suitable for the class; it has been produced for use by introductory college courses and advanced placement high school students.

UNIT	CONTENT
1.	simple dominance
2.	partial dominance
3.	lethality
4.	3 allele trait
5.	4 allele trait
6.	sex linkage
7.	two traits
8.	simple linkage
9.	crossing over
10.	mapping
11.	open experiment and hard tests

This software uses a series of fictitious organisms for the experiments and trial matings.

7. The software is well-suited for the study of population genetics because it permits the students to determine the numbers of offspring produced. The students should be encouraged to perform each mating twice. Once with a small number of offspring, and a second time with a large number of offspring. This will show how wide variations occur with small numbers. The results that occur when small numbers of offspring are produced can be compared with the material placed on the chalkboard following the motivational discussion of the sex of offspring in a family.

8. The greatest benefit can be achieved from the use of this program if the students are permitted to have several periods in which they can perform the experiments and tests independently, following the instructions contained within the documentation. Encourage the students

to keep accurate written records of all matings performed, the phenotypes and genotypes of the offspring, and the numbers of offspring produced. The teacher should be aware that if small numbers of offspring are expected, but none are produced, it is because the program takes into consideration that genetic combinations sometimes result from random variations in the mating.

9. At the conclusion of the computer activity, instruct the students to place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers and monitors.

Summary:

1. Why do the characteristics of offspring produced from single matings often differ from the characteristics that can be expected?
2. Why should a researcher always test the predicted outcomes using a large population?
3. What factors must be taken into consideration when attempting to predict the results of a mating between two organisms of known phenotype?

Homework: Use your biology textbook to help you complete this assignment.

1. What factors determine the genes that are inherited?
2. Alleles are...
3. How are genes positioned on chromosomes?
4. When do linked traits occur?
5. Why do linked traits sometimes appear to separate?
6. Under what conditions are linked traits most likely, and least likely to undergo crossing over?
7. What are multiple alleles?
8. How do multiple alleles assort throughout a population

Enrichment:

1. Research and report on the relationship between hair color and eye color. Why do people with blond hair often have blue eyes?

2. Investigate the relationship between red hair and freckles. Why are some people born who exhibit only some of these traits?

3. Why is hemophilia called a sex-linked condition?

TOPIC 92
Evolution

Aim: What is the evidence for evolution?

Performance Objectives: Students will be able to:

- explain why fossils are evidence for evolution
- describe specific types of fossils
- explain how fossils form
- define the term "index fossil"
- describe the geologic time scale

Materials:

- Apple computer
- software: Crossword Magic by Mindscape
- samples of fossil seashells, petrified wood, picture of dinosaur bones
- geological time scale worksheet

Do Now:

Define fossil, petrified, igneous, sedimentary, evolution

Motivation:

1. Display one or more fossil specimens. Challenge the students to explain how the fossils formed.

2. Review student responses and elicit that fossils are found only in sedimentary rock. The fossils form when sea shells and other remains of living organisms are buried in sediments. Describe other forms of fossil preservation. Insects preserved in amber, wolly mammoth remains frozen into ice and preserved, imprints of dinosaur tracks.

3. Challenge the students to determine the relative ages of the fossil specimens that were displayed.

Development:

1. Ask: What must we know before we can determine the relative ages of the fossils. Elicit from the students that since most fossils are found in sedimentary rock, the fossils that are older were contained in sediments that were laid down first. The older fossils are found at greater depths.

2. Introduce the concept of the "index fossil" and explain how index fossils can be used to determine the relative age of fossils found at sites that are far from each other.

3. Use a crossword puzzle developed with the CROSSWORD MAGIC program to introduce the vocabulary and basic concepts of evolution.

Sample Vocabulary list

evolution
fossil
paleozoic
evidence
sedimentary
mesozoic
petrification
index
cenozoic
cast
precambrium
mold
amber

Sample clues: The clues should be presented to the students within the crossword puzzle format provided by the software. Because many of the students may not be familiar with the vocabulary, a list of the words should be presented to the students on the chalkboard. The students should be forced to match the vocabulary words with the correct definitions before being able to complete the puzzle.

1. a fossil which can be used to determine the relative ages of other fossils.
2. rock formed from sediments that have been cemented together naturally.
3. The hardened gum or resin given off by trees.
4. Changes which occur in livings things over an extended period of time.
5. The preservation of formerly living organisms which occurs when the empty spaces are filled with minerals.
6. When rock forms around a dead organism.
7. When a mold becomes filled with mineral deposits.
8. A dinosaur footprint is an example of this.
9. Remains of living organisms preserved primarily in sedimentary rock.
10. The era which contains only bacteria, algae and invertebrate fossils.
11. The era in which the first insects and amphibians appeared.
12. The age of mammals.
13. The age of reptiles.

Summary:

1. Why are fossils considered to be evidence for evolution?

2. What changes do we observe in the fossils remains of living organisms as we move from precambrian rocks to cenozoic rock layers?

3. Describe three ways in which fossil formation may occur?

Homework:

Complete the geological time scale worksheet with the help of your biology testbook or a book on evolution.

Enrichment:

Investigate the use of radioactive dating to determine the age of rocks and fossils. Within your report you must discuss the concept of the half-life and explain why radioactive dating can only be used to date fossils that are less than 35,000 years old.

WORKSHEET — Geological Time Scale

Name ____________________ Class ______________ Date ________

ERA	ERA BEGAN YEARS AGO	BIOLOGICAL EVENT THAT OCCURRED	PERIODS	EPOCHS
	4 - 6 billion			
Paleozoic				
		Dinosaurs dominant Dinosaurs became extinct		
Cenozoic				

TOPIC 93
Abiotic Factors in the Environment

Aim: What is the effect of abiotic environmetal factors on living organisms?

Performance Objectives: Student will be able to:

- explain the interaction between organisms and their environment
- list the factors that constitute the environment
- list the five abiotic environmetal factors
- explain why photosynthetic plants need light
- describe the relationship between the absorption of sunlight in a body of water and the rate of photosynthesis
- define the terms photic and aphotic zones and describe the kinds of organisms that exist in each zone
- tell how a cactus and a lizard adapt to shortages of water
- list the gases in the air and describe why carbon dioxide and oxygen are essential parts of the air
- explain how temperature changes affect plants and animals
- describe the formation of soil
- describe four ways that abiotic environmental factors can impact on an organism

Materials:

- IBM computer lab
- software: Environment I: Habitats and Ecosystems by IBM
- an ant colony
- geranium or other appropriate plant

Do Now:

Define environment, photic zone, aphotic zone, habitat, ecosystem

Motivation:

Demonstrate the following to the class:
1. the ant colony
2. a pair of plants - one partly covered with black paper, another open and exposed to sunlight

Elicit that ants are living organisms that live and interact with a non-living part of the environment - the soil. Demonstrate that plants need another non-living part (factor) of our environment - sunlight.

Development:

1. After the motivational activity, discuss that the environment consists of both living and non-living components.

2. Challenge the students to list the factors that make up the non-living part of the environment such as air, water, sunlight, temperature and soil.

3. Review the students' responses and tell them that the program they are about to use will teach them the major factors that make up the abiotic, or non-living part of the environment. It will also teach them how

abiotic factors affect living organisms. Tell them that the program is an interactive one and will allow them to answer questions, interpret data, and select various non-living factors in the environment to explore.

4. Remind the students of the correct method for handling disks and tell them to insert their disk into drive "A". The students should turn on the monitors and computer power. The program is self-loading.

5. When the menu appears on the screen, instruct the students to select option #1 - Abiotic environmental factors.

6. The computer-directed instruction starts by explaining that organisms interact with their environment which consists of both biotic and abiotic factors. The major abiotic factors are listed and the student then has an opportunity to learn through a series of interactive explorations about each of the abiotic factors, and how they affect living organisms.

7. Allow the students a reasonable amount of time to complete the computer-directed activity and self-contained review. Suggested time is 10-15 minutes. Instruct the students to stop the program at the end of the quiz, to remove the disks from the machine, turn off the computer, monitor and power switches, and remind the students to put the diskettes into the protective covers carefully without touching the recording surface.

Summary:

1. What is the interaction that exists between organisms and their environment?
2. Name the two factors that constitute the environment.
3. What are the five abiotic environmetal factors?
4. Why do photsynthetic plants need light?
5. How can we describe the relationship between the absorption of sunlight in a body of water and the rate of photosynthesis at various depths?
6. What is the meaning of the terms photic and aphotic zones?
7. What kinds of organisms exist in each zone?
8. How do cacti and lizards adapt to shortages of water in their environment?
9. What are the gases that make up the air?
10. Why are carbon dioxide and oxygen essential parts of the air?
11. How do temperature changes affect plants and animals?
12. How does soil form?
13. In what ways do abiotic environmental factors have an effect on an organism?

Homework:

1. Have students study the appropriate section in their textbooks on abiotic environmental factors.
2. List the five abiotic environmental factors.
3. Justify each of the following. Abiotic environmental factors can:
    a. affect the growth of an organism or determine its survival
    b. force organisms to adapt
    c. place a limit on where an organism can live (except humans)

d. affect another environmental factor by interacting with certain organisms

Enrichment:

An increase of carbon dioxide in the atmosphere by a very small percent might increase the earth's temperature due to the Greenhouse Effect. Research and report to the class on the impact this might have on the biosphere.

TOPIC 94

Nutritional and Energy Relationships in an Ecosystem

Aim: What is meant by energy flow in the food chain?

Performance Objectives: The students will be able to:

- understand the concept of "energy" in the ecosystem
- understand the concept of high feeding levels and low feeding levels in a food web
- understand the passage of energy from one level to the next in a food chain

Materials:

- Apple IIe computer lab
- software: Food Chains and Webs by Prentice-Hall, disk 1, side 1, disk 2, side 4

Do Now:

List three different types of machines and identify the source of energy they require.

Motivation:

Why do all organisms need some form of nutrition? Name a machine that needs energy. Are all energy requirements alike?
Explain how the need for energy and the passage of energy itself are really the thread of survival in all ecosystems.

Development:

1. Introduce a food chain by placing a diagram on the board. Show the students how energy flows through the ecosystem.

2. Introduce the computer activity. Have students turn to the computer, insert disk #1 side 1 into the computer. Have students select option 3 (instruction) from the menu. The computer will then instruct the students to insert disk #2, side 4.

3. Ask the students: What forms of energy are displayed on the screen? Does it surprise you to think of cars, lamps and people as all being consumers of energy? Do these three energy consumers use the same kinds of energy? The same amounts? Allow the students some time to match the energy and consumer chart.

4. Ask: What does a picture of children have to do with energy? What are feeding levels? What is meant by feeding level location? Again, allow the students a few minutes of independent work time.

5. After the independent work on the computer has been completed ask: What feeding level does grass occupy? Is it a consumer or a producer? What about a rabbit? ... a mountain lion? What is unique about the feeding level of humans?

6. Return to the computer program and ask: Does 100% of all energy in the food chain reach each consumer? Why not? Have the students check their responses with the computer program.

7. What important life functions is energy used for within the food chain? Refer back to the computer program and ask: What do the red arrows represent in the diagram of the food chain? What do the white arrows represent? Which organism depicted in the program has the most direct energy available to it? Tell the students to press <RETURN>, then ask them: What does the program display tell us about feeding levels? Which organism in the computer display is at the highest level of feeding? Why? Which organism is at the lowest level of feeding?

8. Ask: Where are the larger populations of species to be found, at the lower levels of the pyramid or the higher? In other words, should there be more consumer organisms or producer organisms at the top? What can you tell us about energy levels at the bottom? Where is the passage of energy the highest?

Summary:

1. What basic need do organisms have in common?
2. Where does the passage of the greatest amount of energy occur in a food chain? Why?
3. Does 100% of all energy get passed from producer to consumer? Why?
4. If you wanted to increase the population of higher level consumers in a given environment would it be a simple matter of just bringing these additional organisms into the environment? What else must be done?

Homework:

1. Construct a food chain with the following organisms:
   rabbit, grass, hawk, owl, grasshopper, bear, wild berry bush

2. Place each of the organisms in the proper order and then indicate where the energy levels are the highest. Also show by the use of a pyramid where the greatest species populations lie. Explain your answer.

TOPIC 95

Cycles of Materials in the Environment — Nitrogen

Aim: What is the nitrogen cycle?

Performance Objectives: The students will be able to:

- explain why nitrogen must be "fixed" before it can be used by most living organisms
- describe the nitrogen cycle and the reactions and transfers that occur to nitrogen in ecosystems
- explain how nitrogenous compounds enter the soil and become nitrates
- describe how some bacteria and blue-green algae convert atmospheric atmospheric nitrogen into nitrogen compounds
- define symbiosis and describe the symbiotic relationship that exists between legumes and nitrogen-fixing bacteria
- describe how saprophytes decompose animal waste and dead organisms, recycling the nitrogen

Materials:

- MS-DOS computer lab
- software: The Environment II - Cycles and Interactions by IBM
- large classroom chart of the nitrogen cycle
- classroom chart of the gases in the atmosphere
- small package of plant food or fertilizer

Do Now:

Why do people give their houseplants "plant food"?

Motivation:

1. Display the fertilizer package and call upon one of the students to read the contents. Plant foods contain nitrates or other nitrogenous compounds.

2. Display the chart of the gases within the atmosphere and ask the class: Why must nitrogen be added to the soil if it is the largest single component of the atmosphere? Elicit student responses and explain that living organisms cannot use atmospheric nitrogen directly. The nitrogen must be "fixed" or combined within other substances to form nitrogenous compounds. Plants absorb nitrogen from nitrogenous compounds within the soil.

Development:

1. Introduce the nitrogen cycle and explain how atmospheric nitrogen can be fixed, taken in by producers, eaten by consumers and returned to the atmosphere by decomposers. Use the chart to illustrate the nitrogen cycle.

2. Place the following terms on the board and elicit definitions based upon the classroom discussion.
   nitrogen, nitrogenous compounds, nitrates, nitrogen-fixing bacteria, the nitrogen cycle.

Inform the students that they will use the computers to learn about the nitrogen cycle and the way the nitrogen passes through the biosphere.

3. Distribute the software. If the students are not familiar with the operation of the computers inform them that they should not bend or fold the disks and should not place anything but the disk into the disk drive. Before this program is used for the first time the teacher must prepare a self-loading diskette. This requires that DOS be transferred onto the same diskette as the program. The instructions are provided on page 2-4 of the software documentation. It is strongly suggested that you prepare a back-up copy of the program and use this back-up copy to prepare the self-loading diskette.

4. Instruct the students to insert the disk into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. The program will self-load and the students will be presented with a menu. Instruct the students to select #3 - The Nitrogen Cycle. The teacher should allow 15-20 minutes for the students to complete the computer activity.

5. Introduce the students to the concept that materials move between the biosphere and the abiotic environment. The program then teaches the importance of "fixed" nitrogen and the need for nitrogen in the formation of organic compounds. The program uses a diagram and text to demonstrate the nitrogen transfers and reactions that occur within the environment.

6. The program introduces nitrogen fixing organisms and explains why these organisms are the main source of nitrogen for the higher plants. The program introduces the concept of symbiosis and teaches the students how both the bacteria and the legumes benefit from the relationship.

7. The students are taught how nitrogen travels from producers, through herbivores and into predators. The program also explains how the nitrogen returns to the environment through the animal wastes and by decomposition of dead animals. Graphics and text introduce the students to saprophytes and students are taught about the process of ammonification. The program ends by showing the students how materials are recycled naturally through the environment. The program is followed by a short quiz. If the students select 2 wrong answers they are presented with additional instruction.

8. At the conclusion of the computer activity, instruct the students to place the diskettes back into their protective envelopes, close the disk drive doors and turn off the computers and monitors.

Summary:

1. How would life on Earth be affected if all of the nitrogen-fixing bacteria and blue-green algae would suddenly die?

2. What is a "material cycle"?

3. What is a chemical compound? How do nitrates differ from atmospheric nitrogen?

4. What is the role of decomposers in the nitrogen cycle?

Homework:

Use your biology textbook glossary to help you complete this assignment.

define each of these terms: nitrification, denitrifying bacteria, nitrogen-fixing bacteria, legumes, mutualism, saprophytes, predators, symbiosis, decomposer.

Enrichment:

1. Use the chemical formulae to demonstrate the way that nitrogen travels from the abiotic environment through the biosphere and back to the abiotic environment. What prevents atmospheric nitrogen from being used directly by most living organisms?

TOPIC 96
Cycles of Materials in the Environment — Carbon Dioxide & Hydrogen

Aim: How are carbon dioxide, hydrogen and oxygen cycled through the environment?

Performance Objectives: The students will be able to:

- name the gases found within the Earth's atmosphere
- describe the process of respiration and identify the products that result from respiration
- explain that water provides plants with the raw materials (oxygen and hydrogen) for the process of photosynthesis
- describe photosynthesis as the source of atmospheric oxygen
- describe the way that carbon from atmospheric carbon dioxide becomes organic matter as a result of photosynthesis
- explain how the water cycle results from the oxygen and hydrogen cycles
- trace the movements of carbon, hydrogen and oxygen through the atmosphere and describe the chemical reactions that occur within these cycles

Materials:

- MS-DOS computer lab
- software: The Environment II - Cycles and Interactions by IBM
- classroom chart of the water cycle
- table of the gases contained within the atmosphere (may be placed on the blackboard by the teacher)
- large beaker or glass for water

Do Now:

Where does our drinking water come from?

Motivation:

1. Take a glass beaker and fill it with water in front of the students. Ask the class: How old is this water?

   Elicit student responses and list them on the board. Review the student responses and then tell the students that a long time ago a dinosaur might have bathed in this water. This should introduce the concept that the water is very old.

   What happened to the water after a dinosaur bathed in it? Introduce the water cycle chart and demonstrate how water travels in a cycle by evaporating into the atmosphere and then returning to the Earth as rain. The students should develop the concept that nature recycles and purifies water as a result of evaporation and condensation.

Development:

1. Ask: What gases combine to form water? If the students do not recall the constituents of water, write the formula on the board.

2. What happens to water during photosynthesis? Review the process with the students and demonstrate, through the use of the formula, the way that

water provides green plants with the hydrogen and oxygen that are necessary for the formation of glucose. Emphasize that the hydrogen and oxygen, which were inorganic, became parts of an organic molecule. The students should develop an understanding that materials move from the abiotic environment into biotic organisms and are then returned to the abiotic environment.

3. Display the table of atmospheric gases and ask the students: Where are these gases found inside living organisms? Elicit student responses and place the formula for glucose on the board. The students should observe that carbon, hydrogen and oxygen are the constituent parts of the glucose molecule.

4. Introduce the computer activity and explain to the students that they will use the computer program to learn how carbon, hydrogen and oxygen move in cycles through the environment. Introduce the students to the schematic diagram of the water cycle and demonstrate how the arrows indicate the way that materials flow. Allow 15-20 minutes for the students to complete the computer activity.

5. Distribute the software. If the students are not familiar with the operation of the computers inform them that they should not bend or fold the disks and should not place anything but the disk into the disk drive.

   - If this program is being used for the first time you must prepare a self-loading diskette prior to use. This requires that DOS be transferred onto the same diskette as the program. The instructions are provided on page 2-4 of the software documentation. It is strongly suggested that you prepare a back-up copy of the program and use this back-up copy to prepare the self-loading diskette.

6. Instruct the students to insert the disc into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. The program will self-load and the students will be presented with a menu. Instruct the students to select #4 - Carbon, Hydrogen and Oxygen Cycles.

7. The program starts running and provides the students with information on the composition of the atmosphere. The students learn that in addition to nitrogen, the atmosphere is composed of oxygen, carbon dioxide, water vapor and inert gases. The program informs the students of the percentage of each of these gases. This segment of the program introduces the students to the major organic compounds found in living organisms and demonstrates that they are composed of the same elements as the atmosphere.

8. The program poses questions which lead the students to identify photosynthesis and respiration as the processes that are responsible for transferring elements between the atmosphere and organic compounds.

9. Give the students an opportunity to study the carbon dioxide, oxygen and water cycles. The students select the substance to be studied and the program traces each of these gases through the abiotic environment, photosynthesis, organic matter and respiration. This segment of the program makes use of schematic diagrams to demonstrate each of the

material cycles and the processes that occur as the materials move through the environment. The students are presented with questions and must state that photosynthesis takes the oxygen from water and respiration combines oxygen with hydrogen to form water molecules. If a student answers these questions incorrectly, the program highlights the appropriate parts of the materials cycles from the schematic diagram to provide additional instruction.

10. The program concludes by presenting the students with a reading passage that contains four fill-in type cloze questions. The students are tested on the relationships that exist between the carbon dioxide, hydrogen and oxygen cycles. The students may consult the program help features and also receive help with spelling. If the students make two or more errors, they are returned to the previous segment for review before being given another opportunity to complete the quiz.

11. At the conclusion of the computer activity, instruct the students to place the diskettes back into their protective envelopes, close the disk-drive doors and turn off the computers and monitors.

Summary:

1. What is the source of the water that falls as rain?

2. What elements are found in carbohydrates, proteins and lipids? What is the source of these elements?

3. How does the process of respiration return water vapor to the environment?

4. Environmentalists are concerned about increasing levels of carbon dioxide within the Earth's atmosphere. Is this a legitimate concern? What is the source of this additional carbon dioxide? How did carbon dioxide and hydrogen originally get "trapped" in the fossil fuels?

Homework:

Use the ecology section of your biology textbook to help you complete this assignment.

Draw a schematic diagram showing the carbon, hydrogen and oxygen cycles. Be sure to indicate the processes which serve to transfer these materials between the abiotic and biotic components of the environment. Your diagram must include green plants and one or more animals.

Enrichment:

1. Scientists now believe that conditions on the Earth were very different when life first originated. Write a report on the gases present in the early atmosphere and explain whether materials cycles might have occurred under those conditions. Also be sure to include an explanation for the source of the atmospheric oxygen.

2. What is the origin of the elements and compounds found on the planet Earth? What may happen to these substances following the destruction of our solar system when our sun exhausts its food supply?

TOPIC 97
Competition in an Ecosystem

Aim: What is an ecological niche?

Performance Objectives: Students will be able to:

- define niche
- explain how the concept of the niche differs from the habitat
- identify some of the characteristics of a specific organism's niche
- explain how competition occurs when two organisms occupy the same niche
- explain why two different organisms cannot occupy the same niche for an extended period of time

Materials:

- MS-DOS computer labs
- software: NICHE - Ecological Game Simulation by Diversified Educational Enterprises Inc. (DEE)
- biology or ecology textbook
- pens/pencils and paper

Do Now: Define niche, habitat, competition

Motivation:

Describe the experiment that was conducted by the Russian biologist G. F. Gause. In this experiment two closely related types of paramecia were cultured together. After a period of time the smaller paramecium P. aurelia eliminated the larger one P. caudatum. Challenge the students to explain what happened. Why?

Development:

1. Elicit student responses to the motivational question. Introduce the concept of competition and help the students develop an understanding that when two types of organism occupy the same niche competition occurs between the organisms.

    A. What will happen over an extended period of time if two organisms occupy the same niche?

    B. What do they compete for?

2. Elicit a definition for the term "niche" and guide the students to develop an understanding that a niche differs from a habitat. Explain that the habitat is the place where the organism lives, such as a pond, stream or aquarium while a niche is composed of the habitat plus the functions of the organism within the entire ecosystem. For example: both fish and snails can be found within a pond but each occupies a different niche.

3. Challenge the students to identify specific factors that combine to form the niche for a kangaroo rat. List the student responses. Among the responses should be a habitat (North American desert), a food supply or

space in which it can gather or obtain food, competitors that may be found within the region. At this point introduce the computer activity and explain that they will use the computers to play a game in which they must try to keep an organism alive by selecting the appropriate characteristics of its specific niche.

4. Distribute the software and writing paper. If the students are not familiar with the operation of the computers inform them to insert the disk into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. The program will self-load. A self-loading disk must be prepared prior to the first use. Instructions are included within the documentation.

5. This program is a game in which the students select an organism and must specify the appropriate environment, range, and competitor. The students have an option called "predator kill" which can be used only once in each round and reduces but does not eliminate the predators. Allow 15-20 minutes for the students, working in groups, to play the game.

6. Following each turn the students are presented with a screen that presents the following information:

   amount of food present in range
   amount of food taken by predators
   amount of food for the population
   deaths due to predation
   deaths due to starvation or other causes
   births
   current population

   Instruct the students to record the results of each round and try to increase the population. Suggestions for successful play and the correct responses are given within the documentation. This will assist the teacher in guiding the students to achieve success in playing the game.

   The program contains an element of chance. If you play the game twice with the same input numbers, you will not always get the same results.

7. At the conclusion of the computer actvity, instruct the students to place the diskettes back into their protective envelopes, close the disk-drive doors and turn off the computers and monitors. Review the student results and list the complete niche for each of the organisms from the game on the blackboard.

Summary:

1. What is a niche?
2. What happens when two organisms occupy the same niche?
3. How does a competitor differ from a predator?
4. What happens to a population when the predators are removed?
5. What happens to a population when the range in which it feeds becomes overcrowded?
6. What happens if an organism's range becomes too large? Why?

Homework: Use your biology textbook and materials from the library to help you complete this assignment.

1. List five organisms found within New York State that are considered to be endangered species.
2. What niche does each oganism occupy?
3. What factors caused its population to decline?

Enrichment:

What would happen if an organism was introduced into a new country in which the organism found an ideal habitat and few competitors? Conduct research to learn what happened when rabbits were introduced into Australia?

TOPIC 98
Maintenance and Change in an Ecosystem

Aim: How is stability maintained in an aquatic ecosystem?

Performance Objectives: Students will be able to:

- understand the various factors that must be kept in balance to maintain an aquatic environment
- understand how each factor affects the total aquatic ecosystem
- identify what factors can disrupt and change the ecosystem

Materials:

- Apple IIe computer lab
- software: "Water Pollution" by Educational Material and Equipment (EME)
- newspaper articles about fish kills and ecological damage (see sewage discharge in Hempstead Harbor circa June 15,1987, Newsday)
- printer (optional)

Do Now:

What substances are found dissolved in clean lakes and rivers?

Motivation:

Let's imagine a small world somewhere where the waters run clean, where the fish and all the other animals that depend on the lakes and rivers for their home and their food are untouched by any kind of pollution. Describe the conditions necessary for this environment to remain stable and unchanging.

Developmenmt:

1. Load a computer with the related program. When the menu appears have the students select option A - Introduction. Allow students 10-15 minutes to review this part of the program on their own.

2. After sufficient time call attention to the following questions:
   a. How important is water to our survival as living organisms? Why?
   b. What does water provide for us?
   c. Ideally, what important substances are found in water?
   d. Where does the dissolved oxygen come from?
   e. What are some factors that increase oxygen level in the water. (Give some time to this question. The answers may be varied and somewhat complex)

3. Direct the students to research the answers to the following questions from the computer program.
   What does BOD stand for?
   What is the approximate minimum level of dissolved oxygen that must be maintained in the water to keep water animals from suffering respiratory distress? What does ppm mean?
   How do water treatment plants affect the BOD?
   What are some factors that can harm or destroy an aquatic environment?
   Specifically what are some kindes of harmful dumping that occur along a

river or lake?

Summary:

1. Approximately how much dissolved oxygen must be present (ppm) must be present for fish to function adequately?
2. What important elements must be present in a water system in order to maintain a healthy balance for aquatic organisms?
3. Why is water so important to our way of life on this planet?

Homework:

1. Define the following terms: BOD, ppm, oxygen level.
2. Briefly explain the relationship of dissolved oxygen to fish survival. (use the role of BOD and ppm to clarify)
3. Briefly describe the effect of waste disposal and river dumping on the ecosystem.

Enrichment:

Make a collection of newspaper articles dealing with "ocean spills" and "waterway dumps." Use these articles to determine what kind of pollutants were dumped.

TOPIC 99
Definition of Function in a Terrestrial Biome

Aim: What are the basics of terrestrial biomes?

Performance Objectives: The students will be able to:

- explain the meanings of the terms "abiotic" and "biotic".
- classify specific environmental factors as "biotic" or "abiotic".
- explain the importance of abiotic factors in determining the characteristics of a specific biome.
- recognize temperature, rainfall, and light intensity as the major abiotic factors that are used to classify terrestrial biomes.

Materials:

- MS-DOS computer lab - Tandy 1000, IBM PC or compatibles
- software: Terrestrial Biomes by Prentice-Hall Software
- DOS 2.1

Do Now:

List three factors essential for life?

Motivation:

Display a large photograph, slide or other picture of animals in a natural environment which includes rocks or soil, a source of water and sunlight.

Place the following question on the chalkboard:
What conditions are required in order to ensure that these animals will continue to survive? Elicit responses from the students and list them on the board.
Be sure that the student list contains several abiotic factors.

Development:

1. Introduce the terms "biotic" and "abiotic" and assist the students in developing an understanding of how abiotic factors are necessary for maintaining life.

2. Introduce the computer software and inform them that the software that they are about to use will introduce them to the characteristics of terrestrial biomes.

3. Place the following instructions on the board to assist the students in loading the program.
    1. Place the DOS diskette into drive A (the bottom drive on the Tandy 1000).
    2. Turn on the monitor and the computer.
    3. Instruct the students to strike the "enter" key when prompted for the date and time.
    4. When the "A" cursor appears, remove the DOS diskette and place it back into its sleeve, insert program diskette 1 into the drive and close the door.

    5. Type the word "science" and strike the enter key.
    6. The program will load and the title screen and first menu will appear.

4. Instruct the students to select option 2- Instruction. The computer will instruct the students to remove the diskette from drive "A" and insert the second program diskette. The program will provide the students with pictures of a series of biomes and ask the students to classify specific factors as abiotic or biotic and then answer questions about the importance these factors.

5. The program will then use a series of symbols to teach the importance of the temperature, rainfall and light intensity in determining the characteristics of a biome and will provide the students with an interactive exercise based upon the instruction.

6. Give the students a reasonable amount of time to complete the computer activity. Suggested time 15-20 minutes. Remind the students that they can go directly to the glossary from the program by using the help option, and can then return to the same point in the program.

7. At the completion of the program, you may allow the students to use the "evaluation" option from the program menu and test themselves on the material they have learned. During this segment of the program they cannot call the glossary.

8. At the conclusion of the computer-directed activity, instruct the students to remove the diskettes from the machines and replace them in the protective sleeves, turn off the computers and the monitors and prepare to copy their homework.

Summary:

1. What are the major abiotic factors that are used to help classify biomes?
2. Although soil is classified as abiotic, it is partially the result of biotic activity. How is this possible?

Homework:

Use the glossary from your textbook to define each of these terms.
Use each word in a sentence.

a. biosphere
b. biome
c. abiotic
d. biotic
e. terrestrial
f. tropical rain forest
g. deciduous forest
h. desert
i. conifer
j. tundra

Enrichment:

1. Describe the specific abiotic factors that determine the biome in which we live.
2. Research and report on careers related to protecting the environment.

TOPIC 100
Classifying Terrestrial Biomes

Aim: What are the characteristics of the terrestrial biomes?

Performance Objectives: The students will be able to:

- describe the four abiotic factors that determine the characteristics of the terrestrial biomes
- classify the terrestrial biomes on the basis of temperature, rainfall, light intensity and soil quality
- identify the location of each of the biomes on a world map
- identify the some of the flora and fauna associated with each of the major terrestrial biomes
- describe the relationship between latitude and the location of a specific biome
- discuss the relationship between altitude and the conditions which lead to the formation of a specific biome

Materials:

- World Map (map of world temperature patterns would be preferable)
- MS-DOS computer lab - Tandy 1000, IBM PC or compatibles
- software: Terrestrial Biomes by Prentice-Hall Software
- DOS 2.1

Do Now:

Explain the following terms: biome, abiotic, biotic, terrestrial, deciduous, tundra.

Motivation:

Display the world map and ask the following series of questions:

- Where would you find a location that remains warm throughout the year?
- Where would you find a location that remains cold throughout the year.
- Where would you find a location that has warm summers and cold winters?
- What is the relationship between latitude and temperature?
- How should the temperature range of a region help to determine the types of organisms found living there?

Development:

1. Review the student responses to the motivational questions and be sure that the students understand the way in which temperature can help to determine the type of organisms found in a region. Discuss the relationship between latitude and temperature and be sure the students are aware that areas of low latitude generally associated with high temperatures and areas of high latitude are associated with low temperatures (Arctic regions).

2. Introduce the computer software and inform them that the software that they are about to use will teach them about the the four abiotic factors (temperature, rainfall, light intensity and soil quality), and the way in which these factors combine to determine the world's biomes.

3. Review the following procedures to assist the students in loading the software.
WARNING: DO NOT FOLLOW THE LOADING INSTRUCTIONS PRINTED ON THE DISKETTE SLEEVE WHEN USING THE TANDY 1000. THE PROGRAM REQUIRES THE USE OF THE DOS DISKETTE AND WILL NOT SELF-LOAD.

    1. Place the DOS diskette into drive A (the bottom drive on the Tandy 1000).
    2. Turn on the monitor and the computer.
    3. Instruct the students to strike the "enter" key when prompted for the date and time.
    4. When the "A" cursor appears, instruct the students to remove the DOS diskette and place it back into sleeve, insert program diskette 1 into the drive and close the door.
    5. Instruct the students to type the word "science" and strike the enter key.
    6. The program will load and the title screen and first menu will appear.

Instruct the students to select option 2 - Instruction.
The computer will instruct the students to remove the diskette from drive "A" and insert the second program diskette.
The program will provide the students with an instruction menu.
Inform the students that they should select option #2 - The Basics of Terrestrial Biomes.

5. The program will then use a series of symbols to teach the importance of temperature, rainfall and light intensity in determining the characteristics of a biome and will provide the students with the opportunity to classify biomes using the following categories: VL (very low), L (low), M (medium), and H (high). After the students have been familiarized with variations in the abiotic factors, the computer provides the students with a screen which lists the terrestrial biomes and the levels of each of the abiotic factors that are associated with each. The students are then presented with a series of questions on the abiotic factors that determine a biome. The software uses a world map to help the students become familiar with locations of each of the terrestrial biomes on the earth.

6. Allow the students a reasonable amount of time to complete the computer activity (suggested time 15-20 minutes). Remind the students that they can go directly to the glossary from the program by using the help option, and can then return to the same point in the program.

7. At the conclusion of the computer-directed activity, instruct the students to remove the diskettes from the machines and replace them in their protective sleeves, turn off the computers and the monitors and prepare to copy their homework.

Summary:

1. Distribute the rexographed activity sheet and have the students follow instructions to complete the assignment.

2. Review the student responses.

3. Propose several biomes and have several students provide abiotic factors that determine each one.

Homework:

1. In which biome does most of the vegetation lose its leaves in the winter?
2. Which biome is often associated with the moose and the spruce?
3. Which biome contains a permanent layer of frost (permafrost) below the surface soil?
4. What factors are necessary for the formation of a grassland biome?
5. How is it possible for a tundra-like biome to exist near the equator?

Enrichment:

Construct a chart large enough for class display illustrating the biomes of North America in map form, and construct a key showing the abiotic factors that determine each one.

WORKSHEET — Characteristics of Terrestrial Biomes

Name ____________________ Class ______________ Date ________

Aim: What are the characteristics of Terrestrial Biomes

Directions: Complete the table using your textbook and information you learned using the program Terrestrial Biomes.

BIOME	MAJOR CHARACTERISTICS	MAJOR PLANTS	MAJOR ANIMALS
	permafrost	lichens and mosses	
coniferous forest or taiga			bear and moose
	most trees lose their leaves in winter. Cold winters, warm summers		
	heavy rainfall, constant warmth		
	low total rainfall or irregular rainfall	grasses	
	extreme daily variation in temperature, very little rainfall	cacti and succulents	

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TOPIC 101
Climatograms

Aim: How can we read and interpret climatograms?

Performance Objectives: The students will be able to:

- define the term "climatogram"
- read and interpret data presented on a climatogram or other line graph.
- prepare the axes for a climatogram.
- plot a climatogram.
- compare data from two climatograms.
- develop conclusions about climatic factors from the data presented on climatograms.

Materials:

graph paper and data tables (prepared by the teacher)
rulers or straightedges
MS-DOS computer labs, DOS 2.1
software: Terrestrial Biomes by Prentice-Hall

Do Now:

Explain the difference between climate and weather.

Motivation:

Place a table of data on the chalkboard which provides the students with the average rainfall (in cm.) and average temperature (in degrees C) for a specific locale for each of the 12 months in a year. See sample data table.
How can we represent this data using a line graph?

Elicit from the students that we can prepare a line graph using the factors of average monthly rainfall and average monthly temperature as the two axes. Introduce the term "climatogram" and explain to the students that this is a line graph in which we plot the average rainfall and temperature. Show the students how to prepare the axis for a line graph and inform them that we always place rainfall on the horizontal axis and average temperature on the vertical axis.

Development:

1. Place the axis for the climatogram on the board and label the two axes.

2. Call upon students to come up to the board and locate the points from the data table on the graph. Have the students plot the points on the graph and then instruct them to write the name of the month represented by the data points next to the point.

3. Call upon a student to come to the board and connect the plotted points. At this point inform the students that they will use the computers to learn how to read and interpret climatograms.

4. Distribute the software and the DOS disks. If the students are not familiar with the operation of the computers, inform them that they should not bend or fold the disks and should not place anything but the diskettes into the disk drive.

5. Instruct the students to insert the DOS disk into drive "A" and close the door. Tell the students to turn on the power on the computers and monitors. When they get the date/time prompts tell them to strike the space bar. When they get the "A" prompt, instruct them to remove the diskettes and insert program disk #1. They should type the word "science".

6. After they view the title screen, the students will be presented with a menu. Instruct them to select "I"; instruction. The computer will inform them to remove program disc #1 and insert program disk #2 into drive "A". This will provide the students with an instruction menu. The students should select option #3 - "How can we read and interpret climatograms?"

7. Allow the students at least 10 to 15 minutes to perform the activity. The program first presents the students with a data table and gives them the opportunity to identify the points to be plotted on a graph using a cross-hair graphic. The location for the cross-hairs can be changed by using the cursor control keys from the computer keyboard.

8. The students are given the opportunity to prepare a climatogram and are then presented with a series of questions which require that they read and interpret the climatograms (line graphs) to locate the answers.

9. Remind the students that if they need help with the program, or if they do not recall the vocabulary, they can consult the "help" menu by striking the "esc" (escape) key.

   WARNING TO TEACHERS OF REGENTS BIOLOGY: The program states that "in a deciduous forest plants can grow all year." This differs from the temperate deciduous forest contained in the regents syllabus. In addition, the program uses the terminology "coniferous forest" instead of the terminology "taiga".

10. At the conclusion of the computer activity, instruct the students to place the diskettes back into their protective envelopes and then plot the climatogram (line graph) which is presented to them on the rexographed sheet.

Summary:

1. What type of biome is represented by the climatogram which you have plotted?
2. How would this biome change if the average monthly rainfall would decrease considerably ?
3. What would happen to the flora and fauna of this region if the average temperature would decrease considerably for a period of many years?

Homework:

1. Use your biology textbook to help you complete this assignment. For each of the biomes listed below, write a short paragraph describing the temperature and precipitation patterns. Be sure to include a description of the flora and fauna associated with each biome.

2. Extra Credit: Parts of the African continent have been experiencing major climatic changes that have resulted in the expansion of the desert into areas that were formerly grasslands and productive farmlands. Prepare a research report on this climatic change and discuss the impact that it had upon both the human inhabitants and the flora and fauna of the region.

Enrichment:

1. Research and report on the role of weather satellites in providing data useful for developing climatograms.

2. Determine the factors that cause the interiors of continents to have a wide annual temperature range.

CLIMATOGRAM LESSON

Data Table for Lesson Plan Motivation

Data for a TAIGA or coniferous forest

Month	Temp (c°)	Average rainfall (cm)
JAN	-18.0	3.1
FEB	- 16.0	2.0
MAR	- 13.5	2.4
APRIL	- 1.1	2.3
MAY	6.8	4.0
JUNE	10.5	5.8
JULY	15.8	6.4
AUG	14.9	8.6
SEPT	11.0	7.6
OCT	5.0	5.0
NOV	- 5.8	2.7
DEC	- 13.0	3.0

WORKSHEET — Climatograms

Name ____________________ **Class** ______________ **Date** ________

Instructions: Plot the climatograms for both the grassland and the desert on the same set of axes. Use a blue pencil for the grassland and a red pencil for the desert. Use the completed climatograms to answer the questions.

GRASSLAND

Month	Temp (c°)	Rainfall (cm)
JAN	- 3.2	1.5
FEB	4.8	2.4
MAR	11.8	3.2
APR	15.4	5.0
MAY	18.8	6.2
JUNE	23.9	4.8
JULY	27.0	6.2
AUG	22.2	9.8
SEPT	14.0	8.8
OCT	11.6	6.8
NOV	8.1	4.8
DEC	1.9	2.8

DESERT

Month	Temp (c°)	Rainfall (cm)
JAN	.4	1.8
FEB	1.2	1.2
MAR	1.8	1.1
APR	4.8	1.4
MAY	11.2	1.1
JUNE	12.6	.9
JULY	15.8	.8
AUG	22.8	.3
SEPT	14.0	1.2
OCT	11.0	.8
NOV	5.0	.7
DEC	1.8	1.3

WORKSHEET — Climatograms

Name ____________________ Class ______________ Date ________

PLOT the climatograms in the space provided

Questions:

1) During how many months does the average temperature in each biome go below 0° C. ____

2) How do freezing temperatures help to determine the type of plant and animal life found in the two biomes? __________________________

____

3) When does the coldest month, the warmest month, the driest month and the wettest month occur in each biome? _________________________

____

4) Based upon your observations of the two climatograms, what is the major cause of environmental differences between a grassland and a desert?

____

____

TOPIC 102
Characteristics of the Intertidal Zone

Aim: What are the characteristics of the intertidal zone?

Performance Objectives: The students will be able to:

- explain the meanings of the terms "abiotic" and "biotic"
- classify specific environmental factors as "biotic" or "abiotic"
- explain the importance of abiotic factors in determining the characteristics of the specific marine biomes
- describe the environmental factors and representative life forms found in the intertidal zone
- draw a cross-section diagram of the intertidal zone and describe how this environment changes with the tidal cycle
- describe the tidal cycle and the relationship between time and the tides
- describe the environmental factors that make life in the intertidal zone a constant struggle to survive in a hostile environment
- identify organisms that can survive in the intertidal zone and the special adaptations and structures that permit them to survive

Materials:

- Apple II computer lab - Apple II, II+, IIe, IIGS, IIc or compatibles
- software: Life Zones in the Ocean by Prentice Hall Software
- photographic slide or large picture of a marine biome showing both abiotic and biotic factors in this environment.
- sea shells, barnacle shells attached to a rock or other object, pieces of dried seaweed.

Do Now:

What causes the ocean tides? How much time is there between one high tide and the next?

Motivation:

Display a large photograph, slide or other picture of a shoreline, beach or underwater environment. The teacher should introduce the lesson by asking the students to describe the environment. The teacher should introduce the terms "aquatic" and "marine" and assist the students in recognizing the characteristics of aquatic or marine biomes. The teacher should explain that the oceans are divided into several biomes.

Development:

1. Place the following questions on the blackboard:
    1. What conditions found at the beach help shoreline animals to survive?
    2. What animals are often found at the beach?
    3. Why does the water level at the beach change throughout the day?
2. Review the terms "biotic" and "abiotic" and assist the students in developing an understanding of how abiotic factors are necessary for maintaining life. Elicit examples of each from the students to ensure that they understand the differences between these factors.

3. Display the sea shells and remains of the other marine animals and call upon the students to identify them. Ask the students to identify specific features that enable them to survive in the intertidal zone. Assist the students in developing an understanding that the intertidal zone reaches from the low tide level to the high tide level and is exposed to both the pounding surf and hot sunlight.

4. Introduce the computer software and inform them that the software that they are about to use will introduce them to the characteristics, abiotic factors and forms of life associated with the major marine biomes. Inform them that they will be studying the characteristics of the intertidal zone today.

5. Instruct the students of the correct method for handling discs. Remind them that they should never touch the recording surface of the diskette, bend or fold it, or place paper clips onto the diskette. If the students are not familiar with the operation of the computers it is also advisable to remind them not to insert anything into the disk drive but the diskette.

6. Place the following instructions on the board to assist the students in loading and operating this program in an Apple disk drive.
   1. Place the program diskette into drive A with side #1 facing up.
   2. Turn on the monitor and the computer.
   3. The program will load and the title screen and first menu will appear.
   4. Inform the students that they should follow the disk operation instructions that appear on the screen. The program is provided on two diskettes and also requires that the diskettes be removed from the drives and turned over to access the other side. Disk #1 contains sides #1 and #2. Disk #2 contains sides #3 and #4.

7. If the teacher is not familiar with this software, it is suggested that the teacher preview the operation of this software package by selecting "preview" from the menu prior to using the software with a class. The preview segment contains information on using the computer with this program, the meaning of symbols, getting help, and getting to the glossary. This program is divided into three segments and is structured using the Prentice-Hall "PIE" menu (preview, instruction and evaluation).

8. When the first menu appears on screen, instruct the students to select "I" (instruction). Instruct the students to select option #1 - "The Intertidal Zone" when the "Instruction" menu appears. As the students work with this segment of the program they learn the following information and perform the following activities:
   a. to recognize the intertidal zone and the range of tidal variations that occurs;
   b. that the tidal cycle is approximately 12 hours long;
   c. to identify intertidal organisms and learn specific facts about each of the organisms. The students select the organisms which they wish to learn about by moving the cross-hairs on the screen. The organisms are limpets, barnacles, sea lettuce and sea anemones. THE TEACHER SHOULD BE AWARE THAT THE PROGRAM DOES NOT USE THE WORD "SESSILE."

d. to recognize the hazards of pounding waves and harsh radiation from the sun that can harm organisms living in the intertidal zone;

e. to identify the specific structures found on each of the intertidal organisms which permit it to adapt to a constantly changing environment. The program gives the students a picture of the limpet and gives them the opportunity to identify the foot and shell. The program states that the shell is composed of "limestone". The program also describes the way that the limpet seals itself to rock by excreting mucus which fills the spaces between itself and the rock;

f. to test themselves on the material which was just learned and to review the topic (if necessary).

9. Allow the students a reasonable amount of time to complete the computer activity. Suggested time 10-15 minutes. Remind the students that they can go directly to the glossary from the program by using the help option, and can then return to the same point in the program.

10. At the conclusion of the computer-directed activity, instruct the students to remove the diskettes from the machines and replace them in the protective sleeves, turn off the computers and the monitors and prepare to answer these questions.

Summary:

1. What are the major abiotic factors that are found in the intertidal zone?
2. What is the definition of the intertidal zone?
3. Why is it difficult for organisms to survive in the intertidal zone?
4. What special adaptations permit animals to survive despite the harsh conditions?
5. Draw a cross-sectional diagram of the beach or shoreline and identify the intertidal zone. Draw pictures of the animals found in the intertidal zone within the diagram.

Homework:

Use the glossary from your textbook to define each of these terms.
Use each word in a sentence.

a. biosphere b. biome c. abiotic d. biotic e. intertidal
f. sessile g. motile h. adaptations i. mucus j. organism
k. sea anemone l. limpet m. barnacle

Enrichment:

Investigate the life cycle of two or more sessile marine organisms. Include information on how these organisms obtain nutrients, protect themselves from dehydration and mate.

TOPIC 103

Abiotic Characteristics of the Neritic and Open Sea Zones

Aim: What are the abiotic characteristics of the neritic and open sea zones?

Performance Objectives: The students will be able to:

- explain the importance of the abiotic factors (pressure, light and temperature) in determining the characteristics of the neritic zone and the open sea
- describe how the abiotic conditions change with depth in both of these zones
- draw a cross-sectional diagram of the neritic zone and the open sea
- define the terms "neritic zone, open sea zone, and continental shelf
- read line graphs depicting changes in the abiotic factors and draw conclusions based upon the data contained in the graphs

Materials:

- Apple II computer lab -Apple II, IIe, II+, IIGS, IIc or compatibles
- software: Life Zones in the Ocean by Prentice-Hall Software
- photograph of the "ALVIN" or another deep sea submersible or bathyscaph
- photographs or slides of the special protective diving suits used for descending to extreme depths in the ocean

Do Now:

What are conditions like in the deepest regions of the ocean?

Motivation:

1. Display the slide or picture of the diving pressure suit and ask the students why deep sea divers must use these heavy suits and not simply the air tanks and masks which are associated with "scuba divers"?

2. Display the pictures of the deep sea submersible? Why are there so many lights on this vehicle? What design characteristics enable it to function at great depths?

   Discuss student responses and be sure to elicit from the students that there is extremely high pressure at great depths and both the diver and the crew of the submersible must be protected from the pressure or they will be crushed. The teacher may wish to draw a diagram on the board showing how all of the water is above the diver and will be pushing down creating high pressure. If the students did not discuss the lack of light at great depths, be sure to point out the large number of headlights on the bathyscaph. Elicit from the students that the submersible and submarines are built with round hulls to enable them to withstand the high pressures.

Development:

1. Ask the following questions or place them on the chalkboard.

   1. How does the open ocean differ from the intertidal zone?

    2. What is the continental shelf?

    3. How can we describe the zone that lies between the edge of the intertidal zone and the beginning of the opean ocean?

2. Discuss the student responses and introduce the term "neritic zone". The students should understand that this zone lies above the continental shelf and is much more shallow than the open ocean.

3. Introduce the term "open sea zones" and describe it as the huge expanses of the open ocean. How does the open sea differ from the neritic zone?

4. Introduce the computer software and inform them that the software that they are about to use will introduce them to the characteristics and abiotic factors associated with the neritic and open sea zones and will also show them how conditions within these zones vary with the depth of the water.

5. Review the correct method for handling disks. Remind them that they should never touch the recording surface of the diskette, bend or fold it, or place paperclips onto the diskette.

6. Review these instructions to assist the students in loading and operating this program using an Apple disk drive.
    a. Place the program diskette into drive A with side #1 facing up.
    b. Turn on the monitor and the computer.
    c. The program will load and the title screen and first menu will appear.
    d. Inform the students that they should follow the disk operation instructions that appear on the screen. The program is provided on two diskettes and also requires that the diskettes be removed from the drives and turned over to access the other side. Disk #1 contains sides #1 and #2. Disk #2 contains sides #3 and #4.

7. When the first menu appears on screen instruct the students to select "I" (Instruction). Instruct the students to select option #2 "The Neritic and Open Sea Zones" when the Instruction menu appears on the screen.

8. As the students work with this segment of the program they will use a bathyscaph to explore the depths of the ocean. As they descend, they will see the changes that occur in the water pressure as the depth increases. The data is presented in meters (depth) and atmospheres (pressure). The students are then presented with a graph that shows the relationship between depth and pressure. If the students have difficulty reading and interpreting the graph, they are instructed to the science skill segment of the program.

9. The students are informed that the open ocean is divided into three zones on the basis of depth: photosynthetic zone, bathysal zone and abyssal zone.

10. The students are then presented with the relationship between depth and light intensity. They are presented with the view from inside the bathyscaph as it descends. They can read the depth guage and observe the amount of sunlight which reaches the ocean depths. The students are

shown that as the bathyscaph reaches a depth of 235 meters, only one per cent of the sunlight penetrates to this depth. This is defined as the bottom of the bathyal and abyssal zones.

11. The students are also presented with information on the relationship between depth and temperature and are presented with a graph and questions on the relationship between depth and water temperature.

12. The students are presented with information on how the neritic zone differs from the open sea zones. The program informs the students that environmental conditions in the neritic zone are similar to those in the photosynthetic zone of the open ocean except for the fact that the neritic zone has an ocean floor. The students should be made aware that sunlight reaches the sea bottom in the neritic zone. This has a major impact on the types of organisms that can survive there.

13. Allow the students a reasonable amount of time to complete the computer activity. Suggested time 20-25 minutes. Remind the students that they can go directly to the glossary from the program by using the help option, and can then return to the same point in the program.

15. At the conclusion of the computer-directed activity, instruct the students to remove the diskettes from the machines and replace them in the protective sleeves, turn off the computers and the monitors and prepare to answer these questions.

Summary:

1. How do conditions within the open ocean and neritic zone differ from the conditions within the intertidal zone?

2. What happens to the pressure, light intensity and temperature as you descend to the bottom of the open ocean?

3. Draw a cross sectional diagram of the shoreline from the coastline to the open ocean. Label and identify the continental shelf, neritic zone, photosynthetic zone, bathysal zone and abyssal zone.

4. Present the students with data tables or worksheets that will give them the opportunity to plot their own graphs showing the relationship between depth and light intensity, pressure and temperature. The students can plot all three curves on the same set of axes by using three different colored pens or pencils.

Homework:

1. Use the glossary from your textbook to define each of these terms:

   1. photosynthetic zone
   2. bathyal zone
   3. abyssal zone
   4. neritic zone

2. Write a short composition describing the conditions that you would encounter if you descended into the ocean depths in a bathyscaph. You must describe the conditions that you would encounter in both the neritic and opean sea zones and use the vocabulary words that you just defined.

Enrichment:

A large colony of chemosynthetic organisms including clams, mussels and giant tube worms has been found clustered around volcanic hot-water vents in a deep region of the ocean. Investigate the role of chemosynthesis and explain how the organisms obtain their nutrients.

TOPIC 104
Survival of Organisms in Marine Biomes

Aim: How do organisms survive in each of the marine biomes?

Performance Objectives: The students will be able to:

- describe the life forms found within each of the marine biomes
- describe the adaptations that permit organisms to survive within each of these biomes
- describe the relationship between the quantity of food available and the number of organisms found within each marine biome
- explain how phytoplankton serves as the primary food source within the oceans
- explain why large fish depend upon phytoplankton as a primary food source
- draw a diagram showing a marine food chain from producer to secondary consumer

Materials:

- Apple II computer lab - Apple II, IIe, II+, IIGS, IIc or compatibles
- software: Life Zones in the Ocean by Prentice-Hall Software
- a chart or poster showing the relative number of organisms found within each of the marine biomes. If this is not available, a diagram can be drawn on the blackboard.
- preserved specimens of shrimp, shellfish, fish, seaweed and other sea organisms.
- prepared slides of phytoplankton, zooplankton and several microscopes

Do Now:

Define: plankton, phytoplankton, zooplankton, abyssal

Motivation:

1. The teacher should display the preserved specimens and ask the students to identify the zone or marine biome in which each of these organisms can be found?
    a. Why can't fish be permanent residents of the intertidal zone?
    b. What conditions must be present for each of these organisms to survive? Elicit from the class that the organisms need a food source, or a source of energy to permit them to perform their life functions.
    c. What is the source of energy for the seaweed? Why can't seaweed be found within the abyssal zone?

Development:

1. Elicit responses to the motivation questions and list the major concepts on the blackboard.

2. Assist the students in understanding the concept that both the type and number of living organisms found within a marine biome is dependent upon both the abiotic conditions and the food supply which is available for the organisms. Introduce the concept of food producers and discuss the relationship between producers and consumers.

Ask: Can consumers survive in an undersea zone which does not contain any producers? Elicit student responses, but not provide a definitive answer. Introduce the computer program and explain that the students will use the program to learn about the life forms found within each of the marine biomes.

3. Review the correct method for handling disks. Remind the students that they should never touch the recording surface of the diskette, bend or fold it, or place paper clips onto the diskette.

4. Review these instructions to assist the students in loading and operating this program using an Apple disk drive.
    1. Place the program diskette into drive A with side #1 facing up.
    2. Turn on the monitor and the computer.
    3. The program will load and the title screen and first menu will appear.
    4. Inform the students that they should follow the disk operation instructions that appear on the screen. The program is provided on two diskettes and also requires that the diskettes be removed from the drives and turned over to access the other side. Disk #1 contains sides #1 and #2. Disk #2 contains sides #3 and #4.

5. If you are not familiar with this software, or did not use the previous segments of this program, it is suggested that you preview the operation of this software package by selecting "preview" from the menu prior to using the software with a class. The preview segment contains information on using the computer with this program, the meaning of symbols, getting help, and getting to the glossary. This program is divided into three segments and is structured using the Prentice-Hall "PIE" menu (preview, instruction and evaluation).

6. When the first menu appears on screen, instruct the students to select "I" (Instruction). Instruct the students to select option #3 - "Life In Each Zone" when the Instruction menu appears on the screen.

7. As the students work with this segment of the program, they will be introduced to the relationship between the abiotic factors and the types of organisms found there. The program starts by showing the students that fish cannot be permanent residents of the intertidal zone because they would be stuck out of water at low tide.

8. The students are presented with a graphic representation showing the relative numbers of fish found within each of the zones. This graphic informs the students that the fish population is highest within the neritic zone and lowest within the abyssal zone.

9. The students are introduced to phytoplankton as food producers. The students are taught that these plankton are found in the upper water layers where they receive sufficient sunlight. The program emphasizes that in the open ocean the phytoplankton are only found near the surface.

10. The students are asked the question: How does the availability of food affect the number of fishes? The students are then introduced to the concept of the food chain and are taught that there is a relationship between the size of an organism and its position on the food chain.

The students participate in an activity in which they select the order in which organisms appear in a marine food chain. As an example: phytoplankton are eaten by small zooplankton, large zooplankton eat smaller zooplankton, small fish each large zooplankton and large fish eat small fish.

11. The students are then taught why most fish are found within the neritic zone. The program emphasizes that the sea bottom is covered with seaweed which contributes to marine life within that zone. In addition, the program also teaches the students that the water within the neritic zone is rich in dissolved minerals which are necessary for food production.

12. The program shows students how the upper layers provide a source of food for organisms within the deep layers. The program introduces the concept of "marine snow" but does not utilize that name. It shows that food particles fall from above and explains that the limited quantity of food within the deep ocean keeps the populations small.

13. The last part of the program introduces the students to specific types of fish and shows the students the adaptations which make the fish well-suited to the zone in which they are found. The first fish depicted is the tuna and the program emphasizes that it is found in the photosynthetic zone. The tuna is described as streamlined and well-suited to moving quickly in the open ocean. The students are introduced to the founder and are shown how it is well adapted to life on the floor of the ocean within the neritic zone. The students are then introduced to the angler fish and are shown the special adaptations which permit it to survive at great depths.

14. This segment of the program ends by reviewing the variations and adaptations that reflect the physical conditions in which they live. The students also participate in an exercise which they select the appropriate food for various types of fish.

15. Allow the students a reasonable amount of time to complete the computer activity. Suggested time 20-25 minutes. Remind the students that they can go directly to the glossary from the program by using the help option, and can then return to the same point in the program. Instruct the students that if they finish early they can go on to the evaluation section of the program and test themselves.

16. At the conclusion of the computer-directed activity, instruct the students to remove the diskettes from the machines and replace them in the protective sleeves, turn off the computers and the monitors and prepare to answer these questions.

Conclusion: The teacher should set up several microscopes and permit the students to have an opportunity to view the prepared slides of the phytoplankton and the zooplankton. The teacher should make the students aware of the fact that the phytoplankton serve as produces because they contain chlorophyll and can manufacture food directly from sunlight. These phytoplankton correspond with green plants in terrestrial biomes. The students should also be made aware that the zooplankton are small animals. They are called the primary consumers because they consume the producers.

Homework:

1. Construct a food chain that might be found within the open ocean by selecting organisms from this list:
   sea lettuce, large zooplankton, small zooplankton, whales, sharks, tuna, flounders, sea horses, phytoplankton, minnows, shrimps, crabs, clams.

2. Construct a second food chain that might be found within the neritic zone. Each organism might be used more than once if appropriate.

Enrichment:

Investigate the life cycles of the individual organisms which are classified as zooplankton.

TOPIC 105

Causes of Environmental Damage in an Aquatic Ecosystem

Aim: What are the causes of environmental damage in an aquatic ecosystem?

Performance Objectives: Students will be able to:

- understand the causes of environmental damage in an aquatic ecosystem
- understand how specific environmental pollutants can damage an aquatic ecosystem
- determine exactly when a given aquatic ecosystem will be ruined by specific types of pollutants
- understand the positive and negative factors that affect an aquatic ecosystem

Materials:

- Apple IIe computer lab
- software: "Water Pollution", by Educational Material and Equipment (EME)
- printer (optional)
- newspaper articles about environmental spills

Do Now:

define biodegradable, non-biodegradable

Motivation:

Hold up copies of local newspaper articles regarding ecological problems (see Newsday circa June, 20 1987). Ask: Why are oil or chemical spills so devastating? What problems do they cause? What do you think of sewage dumping in rivers? Is it really as hazardous for the environment as some experts claim? What effect do you think that continued dumping of sewage and waste might have in the long run on our waterways, lakes etc.?

Development:

1. Discuss student responses to the motivation. What happens to relatively small quantities of biodegradable wastes released into a body of water. Now load a computer with the related program. When the program is loaded ask the students to review the introduction. Have them students select option A.

2. Before the students actually get into this mode of the program, ask them to answer the following questions:
    1. Why is clean water important to all organisms?
    2. What important element(s) are found dissolved in clean waters?
    3. What happens to an aquatic system when the dissolved oxygen levels become very low? Why?
    4. What are some factors that adversely affect our waterways?
    5. How do these various forms of pollution make it very dificult for plants and animals to survive?

   Allow students some time to review the program with a view toward answering these questions. When sufficient time has elapsed briefly discuss the answers to the questions.

3. Ask: What system do we use to determine the amount of oxygen present in the water? How does waste and sewage disposal affect this quantity of oxygen? How do we measure concentrations of pollutants?

4. What does a high BOD level indicate when found in a particular waterway?

5. What gases are present when there is a high BOD level present in the water? Are these gases helpful or harmful? Why?

6. What effect does the temperature of a given waterway have upon the quantity of pollution it can absorb without damage?

7. What happens when a given waterway reaches an "intolerable" level of pollution.

Summary:

1. What is BOD?

2. How do we measure oxygen concentration in water?

3. How do we measure the pollutant concentration of water?

4. How can we predict when a "fish kill" will occur?

5. What are two major sources of water pollution?

6. Why is "dumping" so dangerous to fish? How can we correct the problem?

Homework:

List as many factors as you can that affect the balance in an aquatic ecosystem - these can be either positive or negative.

What negative factors in an aquatic ecosystem could be altered to reduce the effects of pollution in our water.

Enrichment:

Investigate the concept of the "balanced aquarium." What sources of pollution exist within the aquarium? What conditions keep it in balance?

TOPIC 106
Water Pollution

Aim: How does pollution causes environmental damage in an aquatic ecosystem?

Performance Objectives: Students will be able to:

- describe how various factors affect the environment
- manipulate variables to see how an aquatic ecosystem can be drastically altered using a computer simulation
- determine what conditions life in a specific environment will be destroyed

Materials:

- Apple IIe computer lab
- software: "Water Pollution" by Educational Material and Equipment (EME)
- printer (optional)

Do Now:

How do fish obtain oxygen?

Motivation:

Today we are going to run a computer simulation to try to understand how water pollution can specifically change or destroy the environment. What factors must we concern ourselves with if we wish to understand the effects of pollutants on a given waterway?

Developmenmt:

1. List these factors on the board:
   a) type of waterway b) water temperature c) type of pollution
   d) amount of pollution e) existing type of treatment facility

2. Load a computer with the related program. When the menu appears have the students select the experimental mode (option B). Call on a student to read the six environmental "specs" that appear on the computer screen.

3. Ask: Why is knowing the waterway type important to this study? What effect does water temperature have on pollution rate?

4. What is the dumping rate? How is it measured? What type of treatment exists for the waste?

5. Why is time a factor in this study?

6. Have the students input the following set of specs for the simulation:
   A. Body of Water - Lake D. Dumping rate - 9ppm
   B. Water temperature - 10-32 degrees c. E. Number of dumps - 30
   C. Type of dumping - industrial waste F. Type of Treatment - none

7. After the computer has processed this information have the students press <2> (display chart). Ask: What has the computer projected will be the end result if the simulation is run? Does a fish kill occur? After how

many days? What is the percent of dissolved oxygen on this date?

8. Tell the students to press the #3 key (display plot) to see the graph for the projection. What does the blue line represent on this chart? What does the purple line represent? What do you notice about the dissolved oxygen level in the area where both lines intersect?

9. Now let's run the same simulation again, only this time let's change from dumping industrial waste to dumping raw untreated sewage.

10. Allow students time to make the necessary selections and run the program. When this has been done ask them to take note of both the table and the plot.

11. How does the change from dumping industrial waste to dumping sewage affect the simulation? Is the level of dissolved oxygen in the lake better off, worse off or the same?

12. When does a fish kill occur? What is the level of dissolved oxygen in the water at that time? What is the level of industrial waste at that time?

13. Now ask how could we possibly save the body of water? What are the options open to us in treating various forms of waste?

14. What would happen if we went back and kept everything the same except this time we added some kind of waste treatment to the program? Would this affect the level of dissolved oxygen in the water?

15. Give students time to run the program again, only this time change the option of waste treatment to primary. Ask them to take note of any major difference.

Summary:

1. What are some factors we must consider when we study the viability of an aquatic water system?

2. What does BOD mean?

3. What does ppm stand for?

4. Approximately what level of dissolved oxygen must be maintained to ensure fish survivability?

Homework:

Distribute hard copy of a previously run program. Ask the students to briefly review the specs of the hard copy. What type of waterway are we studying here? What does the copy indicate for the dumping rate? Is there any type of waste treatment present? If so what type is it? What is the temperature range?

From this sheet have students create their own graph similar to the graphs viewed in previous simulations.
The x axis should be the number of days the simulation has been run. (up to 30)
The y axis should be both the level of dissolved oxygen and the dumping rate (ppm)
Any fish kills should be noted on the graph as well.

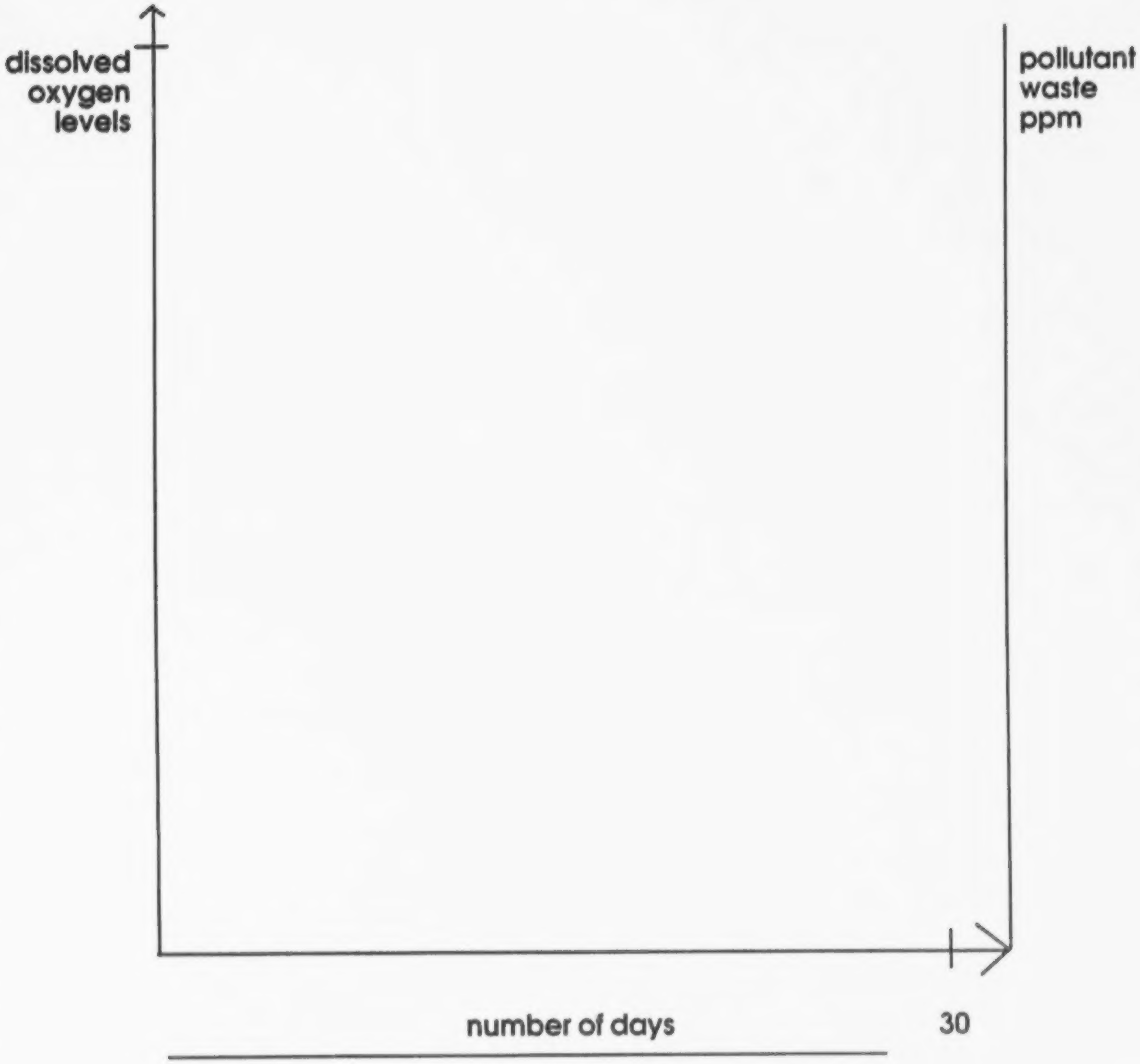
WORKSHEET — Causes of Environmental Damage

Name ____________________ Class ______________ Date ________

Day	Oxygen	Waste
1	8.52	3.12
2	8.45	3.95
3	8.18	5.01
4	7.61	6.11
5	6.78	7.07
6	5.84	7.79
7	5.03	8.25
8	4.47	8.50
9	4.18	8.61
10	4.06	8.65
11	4.03	8.66
12	4.02	8.67
13	4.02	8.67
14	4.02	8.67
15	4.02	8.67
16	4.02	8.67
17	4.02	8.67
18	4.02	8.67
19	4.02	8.67
20	4.02	8.67
21	4.02	8.67
22	4.02	8.67
23	4.02	8.67
24	4.02	8.67
25	4.02	8.67
26	4.02	8.67
27	4.02	8.67
28	4.02	8.67
29	4.02	8.67
30	4.02	8.67

WORKSHEET — Causes of Environmental Damage

Name ____________________ Class ______________ Date ________


dissolved oxygen levels
pollutant waste ppm
number of days
30

TOPIC 107
Parts of the Microscope

Aim: What are the major parts of a microscope?

Performance Objectives: The students will be able to:

- identify the parts of an optical microscope
- describe the function of each part
- explain how to focus using both the fine and coarse adjustments

Materials:

- large chart or poster of a microscope
- Apple IIe computer
- Software: The Microscope Simulator by Focus, side 1

Do Now:

How did the invention of the microscope revolutionize the study of biology?

Motivation:

Display an optical microscope. Why do you think the microscope is one of the most important inventions in the field of biology? Introduce the microscope and provide students with a brief explanation of how it works.

Development:

1. Have students insert side one of the Microscope Simulator into the computer and turn on the power.

2. When the program menu appears, have the students select #1. Ask: What is the first highlighted area the computer has displayed? What is the function of the eyepiece? Instruct the students to press <E> for an explanation of this part. Ask: What word does the computer use to refer to the eyepiece?

4. Have the student continue by pressing the space bar. Ask: What does the computer say regarding the body tube? Press <E> for an explanation. Ask: Why is the distance between the two lenses important?

5. Ask: What is the function of the coarse adjustment? Press the space bar for an explanation.

6. Allow students 10-15 minutes on their own to complete the activity.

Summary:

Place the following vocabulary on the board:
eyepiece, occular lense, body tube, coarse adjustment, fine adjustment, nose piece, high power objective, low power objective, stage diaphragm, mirror base.

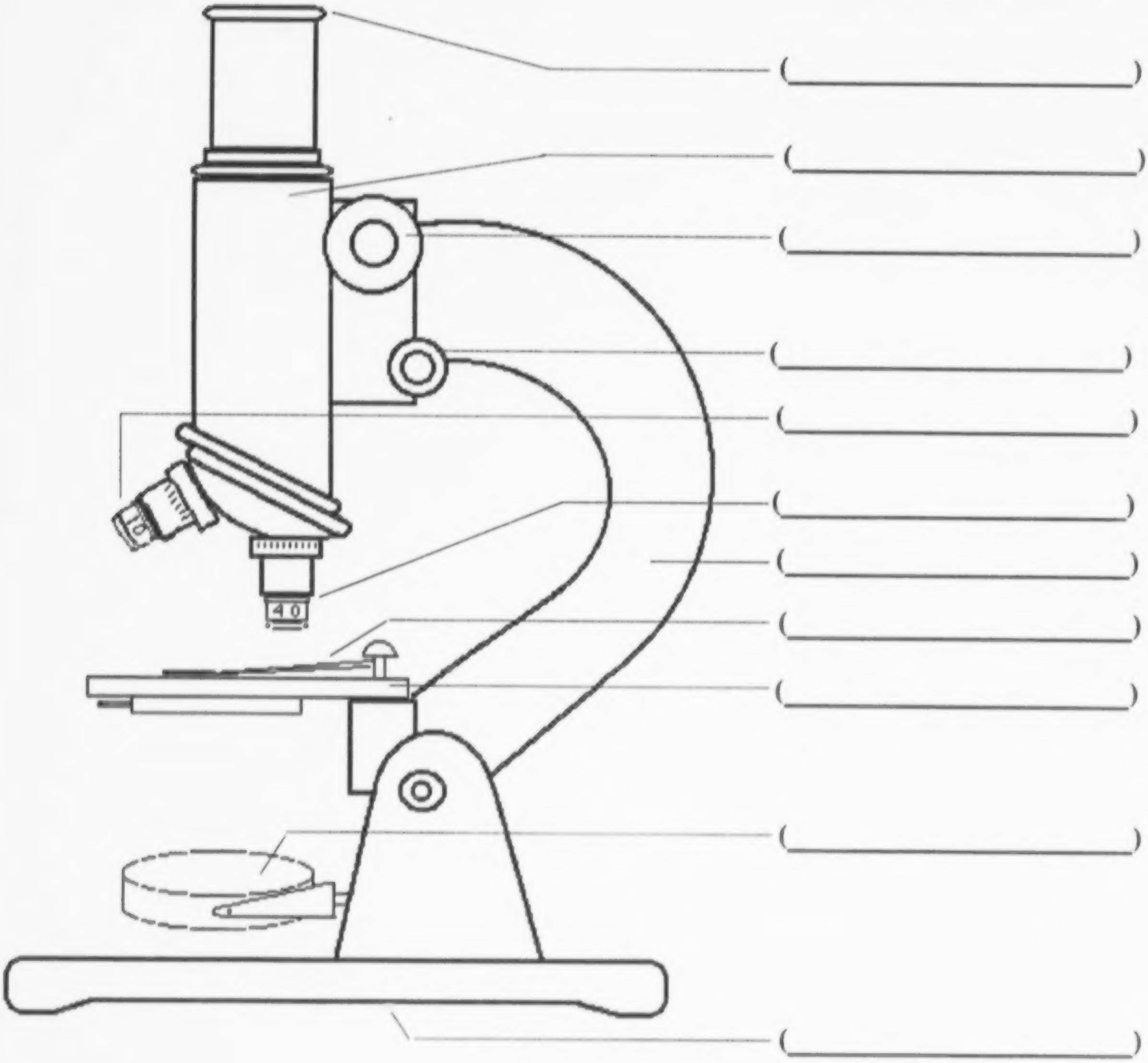
Evaluation:

Distribute a rexographed diagram of the microscope to the students. Have the students press <ESC> then select #3 (Parts Quiz) on the menu. Say: What is the first part the computer asks you to find? Name this in the appropriate space on your rexographed diagram. Continue in this manner until all the parts of the microscope have been displayed by the computer and you have finished the quiz.

WORKSHEET — The Microscope

Name ____________________ Class ______________ Date ________

Label the parts
of the microscope



CHOICES:

High power objective lens
low power objective lens
eyepiece of occular lens
body tube
coarse adjustment

fine adjustment
stage clips
arm
base
diaphram

mirror
stage

TOPIC 108
Measurement of Specimens Under the Microscope

Aim: How do we determine the size of specimens and features viewed under a microscope?

Performance Objectives: The students will be able to:

- compare and estimate the sizes of specimens viewed under a microscope
- know the effects of switching from low-power to high-power microscope objectives
- work with microns (micrometers) and millimeters and convert microns to millimeters
- Use microns and millimeters to determine the size of specimens viewed under a microscope

Materials:

- Apple IIe computer
- software: The Microscope Simulator" by Focus, side 2
- a microscope
- clear plastic metric ruler

Do Now:

Why is it necessary to know the size of an object viewed under a microscope? What other objects besides the cell itself might we choose to measure?

Motivation:

Display the microscope. Ask the students to develop a method for measuring the size of microscopic organisms. Introduce the clear plastic metric ruler and demonstrate the technique for microscopic measurement.

Development:

1. Introduce the term micron (micrometer) and explain to the students that they will use the computer to learn to perform microscopic measurements. Have students turn on the computer with side 2 of The Microscope Simulator in the disk drive. When the program menu appears, have the students select option A.

2. Ask: How can we measure the field of vision? Approximately how big is a millimeter? Show the students the millimeter markings on the metric ruler. How big is a micron? Now have students press <ESC> key and then select B from the menu. Ask: What is the approximate size of the field of vision on the microscope the computer has displayed? Write down the student responses. Now have the students press <RETURN> key.

3. Ask: What do you think is the distance across the line marked X on the field of vision shown by the computer? Press <RETURN>.

4. How many cells approximately 400 microns in diameter make up the field of vision shown by the computer? Now have the students press <ESC>, and then select option C from the menu and press <RETURN>. Do the first part of this assignment with the class. Begin by asking students: How many

cells fit across this field of vision? Is this under low or high power?

5. Now allow students time on their own (approximately 5-10 minutes) to work through this portion of the program. Remind the students to constantly keep a mental note as to whether they are working under high power or low power.

6. After sufficient time ask: Does switching from lower power to higher power change the size of the cell? What does actually change? What do we gain by switching to higher power? What do we lose? What was the approximate size of the field of vision under low power...under high power?

Summary:

1. Approximately what is the size of our field of vision under low power... under high power?
2. How many microns is that?
3. How many microns equal one millimeter?
4. Briefly tell what changes take place in our view when we switch from low power to high power.
5. What else besides the cell itself might we wish to measure under a microscope?

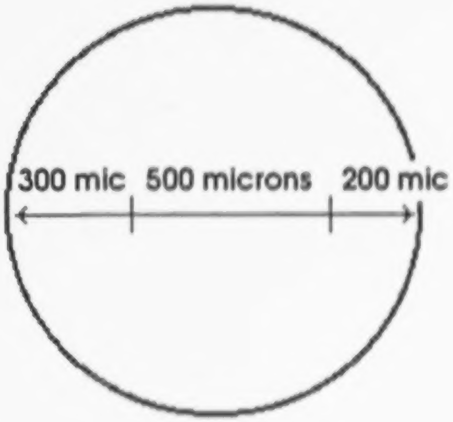
Homework:

1. Answer the questions on the worksheet for this lesson.

WORKSHEET — Microscope Estimates and Measurements

Name ____________________ Class ______________ Date ________

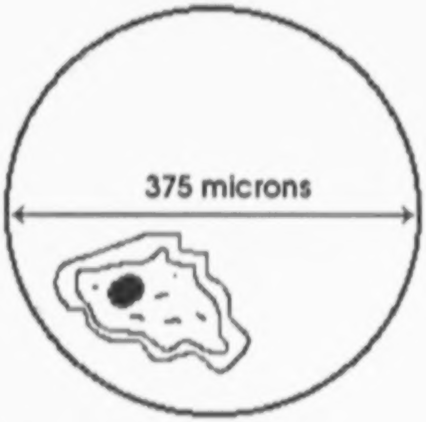
LOW POWER
100X



a) What is the total size of the field of vision in microns? in millimeters?

(__________________)

HIGH POWER
400X



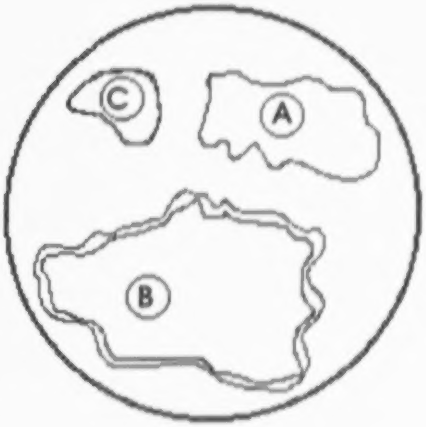
b) What is the maximum distance across the field of vision?

(__________________)

c) Approximately what is the diameter of the cell pictured above?

(__________________)

LOW POWER
100 X



1) Approximately how many cells of specimen A type would a student expect to see in line under high power?

2) Approximately how many cells of specimen B type would a student expect to see under high power?

3) Estimate the diameter of specimen B in microns.

4) Estimate the diameter of specimen C in microns.

TOPIC 109
Cell Structure of the Amoeba

Aim: How does the amoeba function as a one-celled organism?

Performance Objectives: The students will be able to:

- recognize an amoeba as a one-celled organism
- identify the various organelles of the amoeba
- explain the functions of the organelles
- explain how one-celled organisms perform the life-functions

Materials:

- Apple IIe computer lab
- software: Biology Graphics Review (protozoans) by Micro Learningware
- chart or large display model of an amoeba

Do Now:

Ask students to think of some functions that all living organisms must perform.

Motivation:

Write down the students' answers to the "Do Now" question. Then, say "Let's look at a microscopic creature to see how the various life processes, i.e., (digestion, locomotion, excretion) are performed. Display the chart, identify several organelles, and describe the function of each.

Development:

1. Turn to the related software. When the menu comes on, have the students select #1 Amoeba, activity #3 (Associations).

2. Briefly review the picture on the computer screen by asking some of the following questions: How do you think this creature moves? Does the amoeba appear to have a rigid external structure? Why? Identify each of the organelles shown on the screen and explain the function of each.

3. Follow the directions given on the screen in this association activity. Allow the class about 10-15 minutes to work on this activity independently.

4. When the students have gone through the completed diagram ask them to list in their notebooks, as you record on the chalkboard, the names of the various structures and organelles in the amoeba and where each can be found within the diagram.

6. Review: Place the following vocabulary on the board:

a) contractile vacuole
b) ectoplasm
c) endoplasm
d) food vacuole
e) nucleus
f) plasma membrane
g) pseudopodium
h) endoplasmic reticulum
i)organelle

Call on students to provide a very brief description of each of the vocabulary words listed on the board.

7. If time allows have students turn to activity #1 of the amoeba. Tell them to look at the first question. What does it ask you to do? Notice the diagram; what does the question ask you to find? What letter represents the plasma membrane? What life function does the plasma membrane provide? Which letter points to the food vacuole? Continue in this manner until every letter on the computer diagram has been filled in.

Homework:

Make a complete diagram of the amoeba as developed in class, then have them make a simple chart listing the name of each organelle, its general location and its specific function(s).

Enrichment:

Investigate other microorganisms such as the paramecium, euglena and volvox. Draw a diagram of each and explain how it differs in structure from the amoeba.

TOPIC 110
Organelles of the Amoeba

Aim: How do each of the amoeba's organelles help it to carry on a specific life function?

Performance Objectives: The students will be able to:

- know the shapes, functions and locations of the various organelles of the amoeba
- identify the organelles as represented in a diagram
- know specifically how these organs carry on their functions
- explain how the organelles of the amoeba contribute to the survival of the total cell

Materials:

- Apple IIe computer lab
- software: Biology Graphics Review (protozoans) by Micro Learningware

Do Now:

Name the organelle of the amoeba which is most responsible for excretion of wastes. How is this job accomplished.

Motivation:

Display a chart or model of the amoeba. Call upon one or more students to present answers to the "Do Now" and use the chart to explain how wastes are excreted.

Development:

1. Let's examine the contractile vacuole in detail. What new information is the computer giving us. Specifically, what do we see in and around the contractile vacuole that helps it to perform its job?

2. Ask: What specific substances help the food vacuole to perform its job? What important substance must be allowed to pass through the plasma membrane from the outside? What must be allowed to pass through from the inside?

3. What is the literal meaning of the word pseudopodium? How do the pseudopods actually move?

Review:

Put the names of the organelles on the chalkboard. Ask the students to state some facts about each organelle in regard to its function.

Then place the following biological life functions on the board:

locomotion, digestion, reproduction, nutrition, excretion, protection, homeostasis. Have the students categorize each organelle into one of the headings listed on the board.

Homework:

Define each of these terms, and explain the functions of each:

a) protoplasm
b) cytoplasm
c) semi-permeable membrane
d) nucleus
e) vacuole
f) flagella
g) cilia
h) pseudopod

Enrichment:

Explain how the paramecium and the euglena (two other microorganisms) perform each of these life functions: regulation, nutrition, excretion, locomotion, reproductuion.

TOPIC 111
Cell Structure of the Euglena

Aim: How does the euglena function as a one-celled organism?

Performance Objectives: The students will be able to:

- identify the characteristics of the euglena as a one-celled organism
- identify the various organelles of the euglena
- give the functions of these organelles
- compare and contrast the structure and form of these organelles with that of the amoeba

Materials:

- Apple IIe computer lab
- software: Biology Graphics Review (protozoans) by Micro Learningware
- chart or model of the euglena

Do Now :

List three organelles of the amoeba and describe their functions.

Motivation:

Display the chart or model of the euglena. Call on students to list the basic life functions. Ask students if they can recognize structures that appear to be adapted to perform the life functions.

Development:

1. Have the students select: in Euglena #3, activity #1 (Match It) on the software. Discuss the diagram of the organism that appears on the screen.

2. Ask: What shape does the Euglena appear to take? How does this shape differ from the amoeba? What structures do you see in this organism that appear to be different from the amoeba? Can you recognize any similarities in the structures of the amoeba and the euglena?

3. After this brief overview instruct the students to press the space bar to continue. Ask: What does the first question ask? What is a reservoir? What do you think its function might be? Based on this function, where might be a good location for this organelle?

4. Does an amoeba have a nucleus? What do you think the nucleus of a euglena might look like?

5. Where do we usually find chloroplasts? What color are these chloroplasts? What does this tell us about their contents? Where do you think a nucleolus might be found in the euglena? Is this structure also present in the amoeba? What is its function?

6. Continue with this line of questioning. Briefly review the material covered by the computer program. Tell the students to copy this diagram with relevent vocabulary into their notebooks.

Review:

Have the students make a list of the various structures present within the euglena.
Which are present in both the euglena and the amoeba?
Which are present only in the euglena?

Homework:

1. List and briefly describe those organelles of the euglena which are not present in the amoeba.

2. How do these organelles help to serve the life functions of the euglena?

3. What is the flagellum used for? What mechanism within the euglena causes the movement of the flagellum?

Enrichment:

When does the euglena perform photosynthesis?
Can it survive for extended periods of time without light?

TOPIC 112
Diversity of Life — Plants

Aim: What characteristics are found in plants?

Performance Objectives: Students will be able to:

- describe the five-kingdom system of classification
- classify plants using the scientific name (genus and species)
- describe the broad range of characteristics found in plants
- describe the environmental conditions required by plants
- identify plants as autotrophs or heterotrophs

Materials:

- MS-DOS computer, DOS (if required)
- Software: database program
- representative specimens of various plants including cacti, fungi, aquatic plants, bromiliads or orchids, carnivorous plants, dicots and monocots.
- biology textbooks or other reference books on plant life

Do Now:

Define these terms: monocot, dicot, cactus, succulent, fungus, bromiliad

Motivation:

1. The teacher should display the representative samples of plant life and should ask the students: What characteristics are found in all of these plants? The teacher should elicit student responses and place them on the board.

2. If the student reponses do not include the seven life functions, the teacher should have the students recall the seven life functions which are exhibited by all living organisms.

3. The teacher should then call upon students to explain how the plants on display can perform each of the life functions.
    a. nutrition
    b. transport
    c. respiration
    d. excretion
    e. synthesis
    f. regulation
    g. growth
    h. reproduction

Development:

1. The teacher should review the student responses with special emphasis given to the diversity that occurs within the large grouping of organisms called "plants." For example, when reviewing the student responses on plant nutrition, the teacher should point out that some plants are heterotrophs while others are autotrophs.

2. The teacher should help the students develop the understanding that there is a broad range of diversity within the group of organisms called "plants." The teacher should then introduce the system of scientific nomenclature which is used to classify plants. The techer may wish to select a commonly recognized plant and then place the scientific name on the board (genus and species). The teacher should then explain that the "scientific name" is the last two parts of the complete name of this organism. The teacher should then introduce the nomenclature of taxonomy.

   If the teacher has not taught taxonomy in class, the teacher should define each of these terms and explain significance of the five-kingdom system of taxonomy.

   a. Kingdom
   b. Phylum
   c. Class
   d. Order
   f. Family
   g. Genus
   h. Species

3. The teacher should inform the students that the organisms which we call plants are so diverse that we classify them within four of the five kingdoms. The teacher should introduce each of the following kingdoms and explain what types of plant-like organisms are found within it.

MONERA	PROTISTA	FUNGI	PLANT
bacteria blue-green algae	algae	yeasts, molds, fungi	bryophytes tracheophytes

4. The teacher should then introduce the class project: To develop a plant database in which each student will reseach one or more types of plant-like organisms and obtain the information for inclusion within the database.

5. The teacher should introduce the concept of a database and ask the students to suggest the fields that should be researched for each of the plants. The teacher should explain that once this database is constructed it will become a research tool that will be used by students to obtain information for reports and research projects. The information contained must be accurate and properly filed.

   Although the teacher can adapt the database to the grade level, achievement level and specific needs of the class, it is suggested that each of the following items be included as individual fields.

   SAMPLE FILE

   COMMON NAME:
   SCIENTIFIC NAME: (SPECIES, GENUS)
      KINGDOM:
      PHYLUM:
      CLASS:
      ORDER:
      FAMILY:

HABITAT (GEOGRAPHICAL DISTRIBUTION)
CONDITIONS REQUIRED FOR LIFE:
METHODS OF PERFORMING THE LIFE FUNCTIONS
  NUTRITION- (autotrophic or heterotrophic)
  TRANSPORT-
  RESPIRATION-
  EXCRETION-
  SYNTHESIS-
  REGULATION-
  GROWTH-
  REPRODUCTION-

DESCRIPTION:

PRODUCTS USEFUL TO MAN:

6. The teacher should assign students to research individual plants and should provide the students with suggestions for conducting the research. For example, the students can use reference books in libraries or visit one of the botanical gardens. The teacher may also wish to schedule a class trip to one of the botanical gardens to permit the students to perform the research together. This type of trip would permit the students to observe the tremendous diversity found within the grouping of organisms commonly called "plants." To assist the students in performing their research, the teacher should provide each of the students with a printed copy of the record form containing each of the data fields.

7. At this point inform the students that they will use only one computer for the entry of data and the preparation of the actual database. The teacher should explain the process of data entry and seek volunteers. The teacher may wish to provide the students with the database program and become familiar with the operation of the program. Prior to data entry, the teacher should review the research conducted by each of the students within the class.

Summary:

1. At the conclusion of the class period the teacher may wish to review the system of classification and introduce the word "KPCOFGS" as a device to assist the students in remembering the order in which organism names are listed.

2. As this is an on-going project which will require several weeks for completion, the teacher should plan to return to the topic of plant diversity when the database is completed. At that time, the teacher may wish to make multiple copies of the database data disk and permit the entire class to participate in a research activity using the completed database. Examples of the type of reasearch that can be conducted are given below:
   a. Name and describe five plants that are heterotrophs.
   b. Where are carnivorous plants often found? Why?
   c. Why are blue-green algae classified as monera?
   d. Name and describe five plants that are used as raw materials for the manufacturing of medicines.

e. Name and describe two plants that can be used as synthetic sources for fuel oil.

Homework:

Select the plants for research and obtain the necessary data. Complete the sample database form and enter all of the information which you have ben able to locate. Leave an entry blank if you are unable to obtain information.

TOPIC 113
The Need for Classification

Aim: Why do we need to classify various organisms?

Performance Objectives: Students will be able to:

- describe the need for the classification of organisms
- describe the general system of classification
- make judgements and comparisons regarding the characteristics of different phylum, classes and kingdoms

Materials:

- Apple IIe lab
- software: Classifying Animals Without Backbones, by D.C. Heath

Do Now:

List the seven life functions performed by all living organisms.

Motivation:

Place the following items on the board: rock, euglena, starfish, automobile, phytoplankton
Ask: What if anything do these items have in common?
By applying the criteria of locomotion, excretion, nutrition etc. students might begin to see that all but the first item have much in common. Since a starfish and euglena have much in common, can we say that they are exactly alike? Let's see if we can spot important differences between various species.

Development:

1. Review student responses. Elicit differences between the various organisms. What characteristics does the automobile share with living organisms?

2. Load the software. When the menu screen appears select the "overview" option. Have student work through the overview option by pressing the space bar.

3. When diagrams of animals and plants appear listed with phylum names, ask: How many different phyla do you see listed on the computer screen? Why do you suppose all of the invertebrates are listed this way? What are invertebrates? What are vertebrates?

4. What do you think the "category" arthropods might have in common with the category coelenterates?

5. Allow the students to play the first game on their own. This must be done by returning to the menu (through use of the <ESC> key.) Let's play "Name that Invertebrate."

6. After sufficient time (10-15 minutes) call on different groups of students to list the chartacteristics of the computer-generated animal

(Each group will probably have a different one). Ask each group of students, "What name did the computer associate with each group of characteristics?

7. List the phylum names presented by the computer on the board.

8. Call on each group to list the major characteristics that were generated by the computer.

9. After you have listed three or four phyla, have the students enumerate the characteristics they found for each phylum.

10. Ask: What similarities do we see? Are all phyla exactly alike?

11. What characteristics make the arthropods different from the coelenterates? What characteristics make the mollusks different from the echinoterms, etc.

12. This should lead students to understand that animals like other living things can be grouped into "categories" according to certain basic criteria.

Summary:

1. What are the three major organism categories as classified by the computer?
2. What life processes do they have in common?
3. What are some of the major differences between plants, protists and animals?
4. What are some important characteristics of the coelenterates? What characteristics, if any, do the coelenterates and the mollusks share? How is the structure of a mollusk different from a coelenterate?

Homework:

Choose any two invertebrates viewed on the software.
List as many similar characteristics as you can.
List as many differences as you can between the two categories/phylum.

Enrichment:

Investigate and report on the system of taxonomy used today by biologists. How has the system of taxonomy developed with new discoveries.

TOPIC 114
Biotic Organizations — Classification

Aim: How are plants and animals classified?

Performance Objectives: The students will be able to:

- state that plants and animals are classified into separate groups
- describe the separate characteristics of plants and animals
- explain why the classification of plants and animals is necessary to properly study these organisms.
- define the term TAXONOMY
- name the sub-groupings following each kingdom
- explain the origination of the current system of taxonomy
- name five kingdoms of organisms
- describe the characteristics of each of the five kingdoms

Materials:

- IBM computer lab using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Taxonomy - Classification and Organization published by IBM
- worksheet associated with this lesson

Do Now:

Why do we need a standardized system for classifying or categorizing living organisms?

Motivation:

Place the following specimens on your desk or lab table. A starfish, a frog, a stuffed bird or other animal, a house plant, a mushroom and a rock. Challenge the students to find the specimen that should not be grouped with the others.

Development:

1. Explore the answers offered by the students to your motivational question. Most students will realize that all the specimens except the rock were living organisms at one time.

2. Remove the rock from your desk. Ask the students if they can organize the remaining specimens into two categories.

3. Again explore the answers offered by the class. Guide the students to understand that a specimen can be classified in many ways, e.g. does it fly; does it swim; is it green. However, scientists would probably classify the specimens into two major categories. One category would be plants, the other animals.

4. At this time explain to the students that with the aid of computers you are about to teach them the methods scientists use to classify living organisms. You are also going to illustrate to them the general rules for organizing information.

5. Remind the students of the basic procedures of computer operation. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to load.

6. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a screen identifying the program. In a few moments the menu to this program is revealed. Instruct the students to press the #1 key on the keyboard to enter the section of the program concerned with organization. Allow the students 15-20 minutes to operate and explore the program.

7. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point. After this message, the software goes on to discuss material not covered in this lesson.

8. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. What are the characteristics of members of the animal kingdom?
2. What are the characteristics of members of the plant kingdom?
3. Why is classification necessary to properly study organisms?
4. How would you create a system for ordering information?
5. Define the term taxonomy.
6. What system of classification do scientists use to order living things.
7. What are the sub-categories (taxons) within each kingdom?
8. Name the five major kingdoms and describe the characteristics of the organisms within each of them.

Homework:

1. Complete the worksheet associated with this lesson.

Enrichment:

1. Research the work of Linnaeus in developing the current system of taxonomy. Has this system remained constant over the year?

2. Make a chart comparing the characteristics of members of the plant and animal kingdoms.

3. Find the genus and species of five common animals and five common plants.

WORKSHEET — Biotic Organizations

Name ____________________ Class ______________ Date ________

Part I - Completion Questions

1. The branch of science which deals with the classification of organisms is ________________.

2. Members of the _______________ kingdom have cell walls made of cellulose.

3. There are approximately _______________ different types of organisms on earth.

4. The modern system of taxonomy was created by ______________________________.

5. Three organisms that belong to the animal kingdom are _____________, ______________, and ______________.

6. Three organisms that belong to the plant kingdom are _____________, ______________, and _______________.

7. Following kingdom, the successive taxons are _____________, _______________, ________________, ___________, ______________, and ________________.

8. ________________ and _______________ are members of the Protista kingdom.

9. The most specific taxon is ________________.

10. The most general taxon is ________________.

Part II: Answer the following questions.

1. What characteristics of a dog allow it to be classified as a member of the animal kingdom?

____

____

2. What characteristics of a goldfish allow it to be classified in the same kingdom as a dog?

____

____

TOPIC 115
Biotic Organizations — Classification of Plants

Aim: How are plants classified into Phyla?

Performance Objectives: The students will be able to:

- state the characteristics of thallophytes and embryophytes
- name and describe the groups of the thallophytes
- name and describe the two modern phyla of the plant kingdom
- name two examples from the bryophyta phylum
- name three sub-groups of the tracheophyta phylum
- Describe the gymnosperms and angiosperms
- define monocot and dicot
- offer examples of plants belonging to the dicots
- offer examples of plants belonging to the monocots
- classify a limited number of plants into their proper phylum and class

Materials:

- IBM computer lab using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Taxonomy - Classification and Organization published by IBM
- worksheet associated with this lesson

Do Now:

What characteristics are used to classify a living organism as a plant?

Motivation:

Place the following specimens on your desk or lab table: any house plant and algae growing on the glass of a fish tank (or other example of algae or seaweed). Inform the class that at one time, plants were sub-divided into only two subgroups, and that these two specimens represent an example of each group. Challenge the students to find a relationship between these specimens.

Development:

1. Explore the answers offered by the students to your motivational question. Guide the students to answer that plants were at one time classified as either water or land plants.

2. Tell the students that scientists no longer classify plants on the basis of where they live. Under the modern system of taxonomy, plants are placed in one of two phylum, but these phylum do not characterize plants by the location where they grow.

3. At this time explain to the students that with the aid of computers you are about to teach them about the methods scientists use to classify plants into their respective phyla.

4. Remind the students of the basic procedures of computer operation. Reinforce proper handling procedures for disk-based software.

5. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to load. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a screen identifying the program. In a few moments the menu to this program is revealed. Instruct the students to press the #3 key on the keyboard to enter the section of the program concerned with the classification of plants.

6. Allow the students 15-20 minutes to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point. After this message, the software goes on to discuss material not covered in this lesson.

7. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. How were plants originally categorized?
2. Name and describe the groups of the thallophytes
3. Name and describe the groups of the embryophytes.
4. Describe the differences and similarities between the gymnosperms and angiosperms.
5. Describe the differences and similarities between the monocots and dicots.

Homework:

1. Complete the worksheet associated with this lesson.

Enrichment:

1. Make a chart showing the different plant phyla. Give three examples of plants in each phylum.

2. Why aren't fungi considered members of the plant kingdom?

3. Algae have become economically important plants. What are some industrial uses of algae? How is algae used in the food industry? Do you eat any food which contain product derived from algae?

WORKSHEET — Biotic Organizations - Classification of Plants

Name ____________________ **Class** ______________ **Date** ________

Part I - Completion Questions

1. Water plants were originally placed in the ________________ group.
2. Land based plants were originally placed in the ______________ group.
3. Plants that have a well developed vascular system are placed in the ______________ phylum.
4. According to the current science of taxonomy, all plants are placed into one of two phylum. They are either ______________________ or ____________________.
5. ______________ and _____________ belong to the bryophyta phylum.
6. ____________ are plants that have alternate generations.
7. The class ______________________ are characterized by flowering plants.
8. The class ______________________ are characterized by seeds produced within cones.
9. ________________ are characterized by leaves with veins that form a network and seeds that have two ___________________.
10. ________________ are characterized by leaves with veins that are parallel and seeds that have one __________________

Part II: Answer the following questions.

1. What do corn, wheat, and most grasses have in common?

2. Describe briefly how ferns reproduce.

TOPIC 116
Classification of Animals

Aim: How do we classify animals in the biological system?

Performance Objectives: Students will be able to:

- describe the general criteria for classifying invertebrates
- describe the general criteria for classifying vertebrates
- identify some examples of both vertebrates and invertebrates.

Materials:

- Apple IIe lab
- software: Classifying Animals Without Backbones by D.C. Heath

Do Now:

Define vertebrate, invertebrate, arthropod, protist

Motivation Question:

Write the words "sponge" and "oak tree" on the board. Ask: How are these species alike? In what ways are they different? What characteristics separate a sponge from the plant kingdom. Be very strict in the criteria students use for answers. Try to select only those suggestions that are very specific.

Development:

1. Instruct the students to load the software. When program is loaded have students select the "overview" option from the menu.

2. When the diagram appears ask: Under the word living what three "kingdoms" appear? What are the characteristics of a plant that make it different from a protist or an animal?

3. Ask: What are the characteristics of an animal that make it diffemt from a plant or protist?

4. List the students' answers on the board. Lead the class to see that in some cases the distinction between plant and animal or plant and protist may not be very clear.

5. Review the terms "vertebrate" and "invertebrate" on the board; What is the differences between these two terms? What characteristics does a vertebrate have?

6. Ask: What characteristics does an invertebrate have? What is the major difference between the two subphyla? Under the category invertebrate how many phyla do you see listed? What are they (the teacher should list them)?

7. What might be some major characteristics that all of these phyla have in common? Can any of these organisms make their own food?

Summary:

1. What are the major characteristics that separate plants from animals?
2. What do you think are the major characteristic(s) that separate the two categories of animals? Name some vertebrates... invertebrates. Which group or category appears to be more higly evolved?

Homework:

Apply the biological classification system (kingdom, phylum, class, order, family, genus, species) to the following organisms: zooplankton, amoeba, sponge, arthropod, human

Which two organisms are most alike? Which two are different?

Enrichment:

Write a report on the Swedish naturalist Carolus Linnaeus. Discuss the system of taxonomy which he developed and describe changes that have occured in the system of taxonomy since Linnaeus' book was published in 1753.

TOPIC 117
Phyla of Animals

Aim: How are animals classified into Phyla?

Performance Objectives: The students will be able to:

- state that animals are classified by their symmetry
- explain bilateral symmetry
- explain radial symmetry
- name the nine animal phyla
- give examples of animals in each phyla
- name the seven classes of phylum Chordata
- describe members of the three classes of fish
- explain why scientists do not all agree on the number of kingdoms in the taxonomy system

Materials:

- IBM computer lab using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Taxonomy - Classification and Organization published by IBM
- worksheet associated with this lesson

Do Now:

How can we determine whether a living organism should be classified as an animal?

Motivation:

Place the following specimens on your desk or lab table: a sponge, jelly fish, planaria, nematode, earthworm, snail, grasshopper, starfish, and a frog. Challenge the students to find a relationship between these specimens.

Development:

1. Explore the answers offered by the students to your motivational question. Most students will realize that all the specimens are members of the animal kingdom.

2. Tell the students that scientists consider each of the animals on the table so different that they have placed each one in a separate sub-group. Explain to the students that these sub-groups are called Phyla (singular phylum) The specimens on the table represent all the different animal phyla. Show the class a sea urchin and a clam. Ask a student to place each of these animals next to a related animal on the table.

3. If the student has not correctly identified the related group, have other students try to properly place the animals. Guide the students to the proper placements.

4. At this time explain to the students that with the aid of computers you are about to teach them about the methods scientists use to classify animals into separate categories called phyla.

5. Remind the students of the basic procedures of computer operation. Have the students turn on their monitors and then insert the program disk into the disk drive (drive A if it is a two-drive system). The students must then turn on the computer's power and wait for the software to boot up (load). This software package is self-loading.

6. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a screen identifying the program. In a few moments the menu to this program is revealed. Instruct the students to press the #2 key on the keyboard to select the section of the program concerned with the classification of animals.

7. Allow the students 15-20 minutes to operate and explore the program. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to stop.

8. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. What is the difference between bilateral and radial symmetry?
2. Name some organisms that are characterized by radial symmetry.
3. Name some organisms that are characterized by bilateral symmetry.
4. Which taxon follows kingdom?
5. Name the nine animal phyla and give an example of an animal that belongs in each of the phyla.
6. What are the three classes of fish?
7. Why do scientists disagree on the scheme of classification?

Homework:

1. Complete the worksheet associated with this lesson.

Enrichment:

1. Make a chart showing the different animal phyla. Give three examples of animals in each phylum.

2. What is an amphioxus? Which phylum does it belong to? What characteristics allow it to be placed in that phylum?

3. What are the characteristics of the phylum chordata?

WORKSHEET — Phyla of Animals

Name ____________________ Class ______________ Date ________

Part I - Completion Questions

1. Two animals that exhibit radial symmetry are ______________ and _______________.
2. Two animals that exhibit bilateral symmetry are ______________ and _______________.
3. Humans have ___________________ symmetry.
4. The animal __________ is divided into ____________ phyla.
5. Earthworms belong to the _______________ phylum.
6. Starfish belong to the _____________ phylum.
7. Lobsters belong to the _______________ phylum.
8. Spiders are the only members of the ______________ phylum that do not possess ________________ .
9. The phylum which has the greatest number of members on earth is the _________________.
10. Jawless fish have ________ appendages.

Part II: Answer the following questions.

1. What characteristics of a dog allow it to be classified as a member of the chordata phylum?

2. What characteristics of a whale allow it to be classified as a member of the chordata phylum?

TOPIC 118
Classification of Coelenterates

Aim: What are the basic characteristics of the class of animals known as Coelenterates?

Performance Objectives: Students will be able to:

- describe the basic characteristics of the Coelenterates
- describe these animals in terms of structure and form
- describe the characteristics and structure of the hydra

Materials:

- Apple II lab
- software: Classifying Animals Without Backbones by D.C. Heath

Do Now:

Define coelenterate, radial symmetry, endoderm, ectoderm, mesoderm, nematocysts

Motivation:

Ask students to define the following: a tree, a rock, a cat. Allow time for answers; let them see the gross differences. Then ask, How is an oak tree different from a cactus? What characteristics does each have? This should enable students to see that even though each species is part of the plant kingdom, there remain vast differences between the two. How would you classify a sponge? A jellyfish?

Development:

1. Review student responses to the "Do Now." Display model or chart of a hydra and introduce it. Explain that the hydra is studied in biology as a typical coelenterate. Review its characteristics.

2. Tell the students to load the software into the computer. When the menu appears on the screen, have the students select the "overview" option from the menu.

3. When the overview has appeared, ask students to note the position of the coelenterates on the chart.

4. Ask: What kingdom are the coelenterates part of?

5. What other animals are also on the same "line" as the coelenterates? Tell the students to press the <ESC> key and return to the main menu. Have the students select the option "Name that Invertebrate". At this point teacher should place the following characteristics on the board.
   a) radial symmetry
   b) headless
   c) hollow body
   d) free living
   e) arm/tentacles
   f) cell layer
   g) soft body
   h) sting cells

Since the software generates several different sets of characteristics tell the students to continue pressing the <ESC> key until all eight of the characteristics listed above are displayed on the screen.

6. The students will press the <C> key to make these characteristics appear. If at any time a different characteristic appears, students should press the <ESC> key, return to the menu, again select "Name That Invertebrate", and press C to get eight characteristics exactly as they are described as above.

7. The students should press <G> for glossary if a question regarding a particular characteristic arises.

8. When all eight characteristics have been filled in as they appear above, the students should go on to part B, the species game, which is really a continuation and in-depth study of the coelenterates. Allow about 15-20 minutes for Part A.

9. Before students play Part B tell them to make a written list of all the species generated by the computer at this level. Ask what class these particular species of animal belong to.

Summary:

1. What are the common characteristics of all the coelenterates in the group you've studied?
2. What special or unusual characteristics did you notice in any of the animals listed in this group?
3. How does the hydra compare with the other coelenterates?

Homework:

1. Make diagrams of each animal listed in Part B.
2. List the major similarities and differences of each species listed in this category.

Enrichment:

Write a report on the life cycle of the hydra. Be sure to describe how it performs each of its life-functions.

TOPIC 119
Classification of Arthropods

Aim: What are the basic characteristics of the class of animals known as Arthropods?

Performance Objectives: Students will be able to:

- know the basic class characteristics of the Arthropods
- describe these animals in terms of structure and form

Materials:

- Apple II lab
- software: "Classifying Animals Without Backbones" by Heath

Do Now:

Define arthropod, invertebrate, exoskeleton, insect

Motivation:

Ask students to classify the following items: a bird, a maple tree, a dog.

1. Ask: In what ways are these three alike?
2. How are these three items different from each other?
3. List the common characteristics given by the class.

Development:

1. Ask the students to write some basic characteristics these organisms have in common. Review student responses abd introduce the computer activity.

2. Have students load related software into the computer. When menu appears on the screen have students select the "overview" option from the menu.

3. When the overview appears on the screen, ask students to note the species appearing on the diagram listed on the screen.

4. List these on the blackboard.

5. Tell the students to press the {ESC} key and return to main menu.

6. Have student select the option "Name that Invertebrate".

7. At this point teacher should place the following characteristics on the board:
   a) has a head b) exoskeleton c) sheds outer covering d) bilateral symmetry e) jointed legs f) free living g) three cell layers

8. Briefly discuss each of these characteristics.

   Note: Since the software generates several sets of characteristics, caution students to continue pressing the {ESC} key until the the screen fills with the above eight characteristics.

9. If continued questions arise as to the nature of these characteristics, allow the students time to look up a particular definition in the software glossary. This is done by pressing the <G> key.

10. When all eight characteristics have been printed on the screen by the computer, direct the students to part B of the invertebrate game through the use of <arrow> keys and the <P> key, students should find and list the names of various species of this class.

Summary:

What are the characteristics of the arthropod class? List them again on board. What particular species are a part of this class.
As part of the review allow students time to use the software glossary of this program to define the characteristics of this class.

Homework:

1. Make diagrams of each animal listed as a species in the second half of Part B.
2. Make a list of the major similarities and differences of each listed species within this category.

Enrichment:

Biologists claim that arthropods have evolved from annelids. Write a report investigating the evolution and development of arthropods. Be sure to discuss the characteristics of each of these classes of arthropods.

1. Chilopoda - (centipedes)
2. Diplopoda - (millipedes)
3. Crustacea - (crustaceans)
4. Arachnida - (arachnids - spiders)
5. Insecta - (insects)

TOPIC 120
Classifiaction of Chordates

Aim: What are the basic characteristics of the chordates?

Performance Objectives: Students will be able to:

- understand basic class characteristics of chordates
- describe the animal in terms of structure and form
- understand the uniqueness of the chordate phylum and species

Material:

- Apple IIE lab
- software: Classifying Animals with Backbones by Heath

Motivation:

Ask students to classify the following organisms:
- a crocodile
- a chimpanzee
- an oak tree

Answers should vary. Briefly discuss differences and similarities between the three organisms mentioned. In what ways is a crocodile like a chimpanzee? Teacher should list these similarities on the board.

Development:

1. Have students load related software into the computer.

2. When menu appears have students select the "overview" option.

3. When the overview option has appeared note the position of chordates on the schematic diagram.

4. Ask: What kingdom contains the chordates?

5. What other animals are also on the same line as chordates? What are the names of these other phyla? Have the students press the {ESC} key to return to main menu. Have class select the option "Name That Vertebrate."

   Place on the board the following characteristics:
   a. presence of rod or stiff cartilage (notochord)
   b. dorsal nerve chord
   c. paired slots or pouches in the throat region.

6. Since this particular software generates the phylum on the screen, students will have to continue pressing {ESC} key until characteristics appear on the screen that match those written by the teacher. If characteristics appear that don't match those described, students must exit this mode with use of {ESC} key and then reenter it by selecting "Name That Vertebrate" game from the menu. This process may sometimes take a while because, as noted earlier, the choice of the animal selected is computer-generated.

7. When characteristics appear on the screen which match those mentioned by the teacher, students should list them in their notebooks.

8. Students should then go to play part B of the game, which is really a listing of individual species within the phylum chordate.

9. Instruct the students to make a list of each of the particular species generated by the computer and the unique characteristics.

10. Allow students 15-20 minutes to complete this procedure.

11. When time is up call on a few different groups of students to note the individual species and its related characteristics. Answers will vary, but the teacher should put a few different species names as well as individual species characteristics on the board or on an overhead.

Summary:

1. Are all chordates vertebrates?
2. Are all vertebrates chordates?
3. What is the major difference between chordates and vertebrates?
4. What characteristics do all chordates have in common?
5. What are some species of chordates that you found?
6. What are the very special characteristics of chordates that are unique to each species?

Homework:

Explain the statement: All vertebrates are chordates, but not all chordates are vertebrates. Why?
Make a list of the individual species characteristics that your computer generated.
On this sheet make a notation as to whether these characteristics are unique to the species or common to the phylum. Using the worksheet provided by the teacher, locate and diagram the chordate phylum. Under this listing write a few characteristics of this phylum. Then locate and diagram a few species within the chordate phylum, list a few unique characteristics of each species you diagram in this phylum.

TOPIC 121
Classification of Vertebrates

Aim: How do we classify vertebrates?

Performance Objectives: Students will be able to:

- identify the major criteria for classifying vertebrates
- know the major distinctions betweeen most vertebrates
- list the major phyla in the vertebrate category
- distinguish between vertebrates and invertebrates

Materials:

- Apple IIE
- software: Classifying Animals with Backbones by Heath

Do Now:

Define chordate, vertebrate

Motivation:

Place the words monkey and sponge on the board. Ask the students to list some important similarities between these organisms. Have them list important differences. Discuss each briefly, then ask - in what way are a rattlesnake and a monkey related?

Development:

1. Review student responses to the motivation, then load Apple II with the appropriate software. When program is loaded have students follow computer instructions until the menu appears on the screen.

2. At this point tell the students to select the "overview" option.

3. When overview appears on screen have the group follow computer instructions until a classification diagram apppears on the screen.

4. At this point ask: What are the two major categories of animals that appear on the screen?

5. What characteristics have we learned that all vertebrates have in common? What are some of the phyla listed under the vertebrate category? List student responses.

6. Tell the students to press the {ESC} key to find menu.

7. When menu appears have the students select "Name that Vertebrate game". Students will not actually play the game; instead they will make note of phylum characteristics (8) which appear on the screen.

8. They will use the {ESC} key move from one set of phylum characteristics to another.

9. How many different sets of characteristics did you find? (This number should equal diagram in overview).

10. After all the characteristics have been listed, have students try to speculate as to which set belongs to which phylum.

11. Have group re-enter vertebrate game following the instructions of the computer. Allow time for the students to work through a few rounds of the game on their own.

Summary:

1. What phylum(s) did we study today?
2. What are the major differences within the animal kingdoms?
3. What are the major characteristics that all animals have in common?
4. Which category of animals appears to be more advanced... Vertebrates or invertebrates? Name some advanced species.

Homework:

Prepare a list of the animal phyla you've studied on the computer. Write down approximately five major characteristics of each phylum. Write down similar character between phylum other than backbones: Develop a chart to classify at least two separate phylum and their related species.

TOPIC 122
The Dichotomous Key

Aim: How can we use a dichotomous key to help classify an organism?

Performance Objectives: The students will be able to:

- state the purpose of a dichotomous key
- explain how a dichotomous key can be used to classify organisms
- use a dichotomous key to classify various plants and animals into their proper phylum.

Materials:

- IBM computer lab using: IBM PC, XT, PCjr, or AT computers; minimum of 128k memory with DOS 2.0 or a minimum of 192k with DOS 3.0 or higher
- one or two double-sided disk drives
- color monitors and graphics adapters
- printer (optional)
- software: Taxonomy - Classification and Organization published by IBM
- worksheet associated with this lesson
- one or more dichotomous keys to display or demonstrate to the class

Motivation:

Place several plant or animal specimen on your desk or lab table. Ask the class how they would proceed to place the organisms into their proper phylum?

Development:

1. Explore the answers offered by the students to your motivational question. The students will probably offer several answers and some students will be able to place most of the specimens into their proper phyla. Ask the students if they can explain in a methodic fashion exactly how they would place an organism into its proper phylum.

2. Tell the students that by asking a series of questions that can be answered with a simple yes/no response, they should be able to classify all the organisms. When scientists strive to organize things by this method, they are said to be using a dichotomous key.

3. Inform the students that many problems can be solved by using a dichotomous key. Point out that not all dichotomous keys involve the science of taxonomy. Mechanics use similar methods to assess engine problems. Doctors use this method to probe their patients illnesses.

4. At this time explain to the students that with the aid of computers, you are going to allow them to use a dichotomous key to try to classify animals. Since it only takes a minute or two to classify each animal, they should prepare a list of several animals which they would like to classify.

5. Give each student a copy of the worksheet associated with this lesson. Ask the students to begin their work with the dichotomous key by first classifying the three organisms listed on the worksheet. They must

complete the sheet for homework, but must have access to the computer to answer the questions.

6. Remind the students of the basic procedures of computer operation. The program commences with a blue screen displaying the IBM logo and then automatically proceeds to a screen identifying the program. In a few moments the menu to this program is revealed. Instruct the students to press the #4 key on the keyboard to enter the section of the program concerned with the dichotomous key.

7. Allow the students a reasonable amount of time to operate and explore the program. The students will be quizzed at several points during the progress of this program. If students do not respond correctly to the questions, the program will supply hints to aid the students. If the students require more than two tries to answer a question, the program will supply the answer. At pivotal points of the program, the students will be offered an opportunity to repeat a section of the program if too many incorrect responses are detected.

8. At the conclusion of this section, a message will be displayed that says, "END - Do you want to continue this study or end the lesson for today?" Tell the students to terminate the lesson at this point.

9. At the completion of the computer-guided instructional activity, have the students remove the program diskettes from the computers and return them to the instructor. The students should then turn off the computer switches and monitors.

Summary:

1. What method is used to place organisms into their proper phyla?
2. How is a dichotomous key used?
3. In what occupations can a dichotomous key be used?

Homework:

1. Complete the worksheet associated with this lesson.

Enrichment:

1. Make a chart showing three examples for each of different animal phyla.

2. Make a chart tracing humans through all the taxons.

3. Research the animal called the platypus. When was this animal discovered? How was this animal received by the scientific community? How is this animal presently classified? Why?

WORKSHEET — What is a Dichotomous Key?

Name ____________________ **Class** ______________ **Date** ________

Part I: Classify an earthworm, a crab, and a mouse by using the dichotomous key. In the space below, write down the questions that were asked of you for each organism and write down your responses.

Part II: Which of the three organisms listed above required the most steps to classify? Which organism required the least number of steps to classify? Why do different organisms require different numbers of steps to properly classify them?

Appendices

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Categorical Glossary of Computer Technological Terms

MEMORY

BIT	The smallest unit of information a computer processes.
BYTE	A byte is 8 bits long.
KILOBYTE	1024 bytes of information (memory capacity of a computer.
MAIN MEMORY	The internal storage device of the computer.
MEGABYTE	1,048,576 bytes of information (notes size of memory.
REGISTER	Very fast memory locations found in the central processing unit.

LANGUAGE

BASIC	A programming language for beginning programmers.
COBOL	Common Business Oriented Language.
FORTRAN	(Formula Translation) computer language used by scientists.
LANGUAGE	A set of words or symbols used to give instruction to a computer.
MACHINE LANGUAGE	The only language understood directly by a computer which is composed of binary numbers. Each type of computer has its own machine language.

HARDWARE

ACOUSTICAL COUPLER	A modem which connects a computer terminal to a telephone handset and changes computer signals to signals that can be sent over a phone line.
ANALOG COMPUTER	A computer that works with a continuous scale or measure.
CARD PUNCH	A device which punches holes in a card to represent data.

CARD READER	An input device which senses hole patterns in a punch card and translates them into computer data.
CENTRAL PROCESSING UNIT (CPU)	The part of the computer that interprets instructions and carries them out.
CHIP	A small bit of silicon upon which an integrated circuit is built.
ELECTRONIC COMPUTER	A machine that stores and processes information using electrical and magnetic signals.
CONTROLLER	A device that moves information between a disk and the main memory so the C.P.U. can use it.
DIGITAL COMPUTER	A computer that works with a measure of distinct values.
DISK	A flat circular plate with a magnetic surface layer upon which data can be stored.
DISKETTE	A secondary storage device with a magnetic surface for reading.
DISK DRIVE	A device that plays disks or diskettes.
DIRECT CONNECT MODEM	A modem that connects directly to a phone line.
FIRST GENERATION COMPUTER	Computers that use vacuum tubes.
GRAPHIC DIGITIZER	A graphic input device that changes lines on paper into coordinates that are automatically fed into the computer.
GRAPHIC TABLET	A kind of graphic digitizer where a stylus is used to draw on an electronic tablet.
GRAPHIC TERMINAL	T.V. monitor.
HARDWARE	The physical equipment of a computer.
INPUT/OUTPUT DEVICES	Devices which move data into and out of the main memory of a computer.
INTEGRATED CIRCUIT	A chip of silicon that performs the same function as transistors, capacitors and resistors.
LIGHT PEN	A graphic input device which is light sensitive.
LINE PRINTER	A device that prints a line of characters as a unit.
MECHANICAL PLATTER	A graphic output device, uses pen to draw on paper.

MICROCOMPUTER	A computer that has a microprocessor as its C.P.U.
MICROPROCESSOR	A tiny silicon chip that is the central processing unit of a computer.
MODEM	Changes computer signals into tones that can be carried on telephone lines.
ONLINE TERMINAL	A terminal connected to a computer where data may be entered on telephone lines.
PERSONAL COMPUTER	Table top computer which has a microprocessor as its central processing unit.
PERIPHERAL DEVICES	External devices that can extend a computer's capabilities.
PLOTTER	A graphic output device, draws with pen and ink on paper.
SECONDARY STORAGE DEVICE	Supplementary, external data storage (disk)
SECOND GENERATION COMPUTER	Computers that use transistors, capacitors, and resistors.
TAPE DRIVE	Audio tape recorder used to store computer programs and data.
TERMINAL	A device with a keyboard and display to send and receive information from a computer.
TRANSISTOR	A small semi-conducting device that performs the functions of a vacuum tube.
THIRD GENERATION COMPUTERS	Computers that use integrated circuits or silicon chips.
VIDEO TERMINAL	A terminal with a T.V. screen.
WORD PROCESSOR	A computer used to manipulate written material.

PROCESS

ACCESS	To get a record.
ADDRESS	A number for a location in the computer's memory.
ALGORITHM	A procedure for solving a problem.
BATCH PROCESSING	Gathering information and entering it into a computer all at once.
BENCHMARK RUN	A test run of a program to judge its performance.

BRANCH	To select one of several possible acts of instructions in the execution of a computer program.
BUG	An error.
CHARACTER	A letter or symbol used to represent data.
CODING	A way of shortening data so that it will take fewer memory locations.
COMPILER	A program that changes a computer program written in another language such as Fortran or Cobol, into machine language.
COMPUTER SCIENCE	The study of theories of computation.
DATA	The information that is put into a computer to be processed by a program.
DATA PROCESSING	Taking information and changing it into other useful forms.
DIGIT	Arabic numeral 0 - 9.
DIRECT ACCESS FILES	Files from which records may be taken in any order.
EXECUTE	To perform or carry out.
FEEDBACK	The use of output from input to make the system self correcting.
FILE	A set of related records stored together and treated as a unit.
FIELD	A certain area of a record used for a particular piece of data (age, name).
FIELD TEST	The testing of a computer program on a small scale to correct errors before it is widely distributed.
HARD COPY	A printed copy of machine output.
INFORMATION	Organized data used in a computer program.
INPUT	Information given to a computer.
KEY	The portion of a record used to determine where a record goes in a file.
LOOP	A set of instructions that may be executed repeatedly while a certain condition exists.

MENU	Similar to a table of contents in a book.
OPERATING SYSTEM	A program that controls the execution of computer programs.
OPERATION	A basic function of a computer (addition, subtraction, movement of data).
OPERATION CODE	The portion of machine language that tells the computer what operation to perform.
OUTPUT	The information generated by a computer.
POWER	The speed and storage capacity of a computer.
PROCESS	A systematic order of operation to produce a certain result.
PROGRAM	The instructions that tell a computer what to do.
QUANTIFICATION	The changing of data to measurable quantities.
RECORD	A collection of related data treated as a unit (payroll).
SEQUENTIAL FILES	A file of information which can only be read record by record.
SIMULATION	The development of a model for the purpose of testing a theory.
SOFTWARE	Computer programs.
SUBROUTINE	A self-contained set of instructions used by a program or another subroutine.
SYNTAX ERROR	An error generated by improper input.
SYSTEMS ANALYSIS	Procedures for systematic study of the structure of a system to improve it.
TIME SHARING	The use of a computer by more than one person at a time.
VARIABLE	A part of the program that is changeable.

HISTORICAL FIGURES

Howard Aiken - Developed the Mark I mechanical computer.

John Atanosoff and Clifford Berry - Experimented with the first electronic computer (used vacuum tubes).

Charles Babbage - Designed a calculating machine called the analytical engine.

Presper Eckert - Developed ENIAC, a first generation computer, with John Mauchly.

Herman Hollerith - Developed a punch card system for the census.

Joseph Marie Jacquard - Used punch cards to control looms.

Gottfried Wilhelm Von Leibnitz - Created an early multiplying and dividing machine.

John Von Neumann - Proposed that computers use the binary number system and stored programs.

Blaise Pascal - Created early adding and subtracting machine.

CAREERS

Customer Engineer - A technician who makes sure a computer works properly.

Field Service Engineer - A technician who will travel to a company to fix its computer.

Operations Personnel - Personnel who are directly responsible for making the computer usable.

Systems Analyst - One who studies a system and suggests ways to improve the system.

Systems Programmer - One who creates operating system and languages for the computer.

Software Duplication Guidelines

Like plays, novels, songs, textbooks, and all other published material, the programs and files on a published computer diskette are fully protected by the copyright laws of the United States. No diskette can legally be copied without the appropriate permission of the publisher. The position of the Office of Technology of the New York City Board of Education on diskette copying is clearly stated in the June, 1986 issue of COMPUTALK:

1. Duplication of copyrighted software or documentation is prohibited.
2. Software publishers must be contacted to verify procedure for backup multiple copies and licensing agreements.
3. A publisher's written permission is required to download or network programs to other microcomputers.
4. No student or Board of Education employee may use school computers to duplicate copyrighted software.
5. The use of illegally duplicated software, however obtained, is prohibited in all Board of Education facilities.
6. Simultaneous use of original software and/or its back-up is not permitted without the written permission of the publisher.

The New York City Board of Education has computer diskettes under contract at this time. If you wish to purchase additional diskettes, the Office of Technology suggests that you contact:

Jordan Computer Enterprises, Inc.
1436 Gordon Street
Allentown, Pa. 17102
contract number P27291
vendor number: COM121

Copying Public Domain Diskettes for the Apple IIe and Apple II Plus

To make a copy of your data diskettes or public domain program diskettes, follow these steps:

1. Before proceeding, be sure that the diskette you wish to copy is write protected. Write protecting your diskette will prevent you from accidentally erasing or overwriting any of its programs or files during this or any other use of the diskette. You can write protect a diskette by placing a small piece of opaque tape over the write protect notch on the diskette's left side.

2. Insert the DOS 3.3 System Master diskette into drive 1 and turn the computer and the monitor on. When the Applesoft prompt and cursor appear type in RUN COPYA and press RETURN.

3. The screen will display the message

```
APPLE DISKETTE DUPLICATION PROGRAM
ORIGINAL SLOT:   DEFAULT = 6
```

   Press RETURN.

4. The screen will display

```
ORIGINAL SLOT: 6
       DRIVE:    DEFAULT = 1
```

   Again, press RETURN.

5. The screen will display

```
       DRIVE: 1
```

   and add a new message:

```
DUPLICATE SLOT:  DEFAULT = 6
```

   Press RETURN.

6. The screen will display

```
DUPLICATE SLOT: 6
```

   and ask one last question:

```
       DRIVE:    DEFAULT = 2
```

   If you are using an Apple II Plus or IIe with one disk drive, change the number 2 to 1 and press RETURN. If your machine has two disk drives, simply press RETURN. The screen will display

```
-- Press `RETURN' key to Begin Copy --
```

7A. If you are using a computer with two disk drives, the screen will give you no further instructions. Remove the DOS 3.3 System Master diskette and insert the source diskette into drive 1. (The source diskette is the diskette you want to copy.) Insert the target diskette into drive 2.

(NOTE: It is not necessary to format a new diskette before using it as the target diskette. The Apple II Plus or IIe will format it automatically before copying onto it.)

Press RETURN. Reading and Writing messages will appear alternately as the computer reads the source diskette and writes onto the target diskette. If the target diskette has not been formatted before, the screen will also display Formatting.

7B. If you are using a computer with a single disk drive, press the RETURN key. You will have to alternately insert and remove both the source diskette and the target diskette during the copying procedure. The screen will tell you what to do at the proper times. Follow its instructions carefully. When you insert the target diskette for the first time, the screen will display the word Initializing while it proceeds.

When the screen displays the message

```
DO YOU WISH TO MAKE ANOTHER COPY?
```

the procedure is over; the target diskette has been made into a duplicate of the source diskette.

8. If you want to make another copy of the source diskette, type in Y and press RETURN. The screen will repeat the message

```
-- Press `RETURN' key to Begin Copy --
```

You can repeat this procedure as many times as necessary and make as many copies of your original data or public domain program diskettes, as you need.

Copying Public Domain Diskettes for IBM/Tandy

Diskcopy with One Disk Drive

To make a copy of a data diskette or public domain program diskette on an IBM PC, PCjr, or IBM compatible Tandy computer with a single disk drive, follow these steps:

1. Before you start, be sure that the diskette you wish to copy is write protected. Write protecting a diskette will prevent you from accidentally erasing or overwriting any of its programs or files. You can write protect a diskette by placing a small piece of tape over the write protect notch on its left side.

2. Insert the DOS diskette into the disk drive, turn the computer and the monitor on, wait for the DOS to boot up, then enter the date and time. The last line on the screen will be A>.

3. Type Diskcopy, then press ENTER. The screen will display the message,

   ```
   Insert SOURCE Diskette in Drive A :
   Press any key when ready . . .
   ```

   The SOURCE diskette is the diskette you want to copy. Remove the DOS diskette from the disk drive and insert the Source diskette. Press ENTER.

4. The screen will display a Copying . . . message, then the following instructions:

   ```
   Insert TARGET Diskette in Drive A :
   Press any key when ready . . .
   ```

   The TARGET diskette is the diskette you want to copy to. Remove the source diskette from the disk drive and insert the Target diskette. (NOTE: It is not necessary to format a new diskette before using it as the target diskette. Diskcopy will format automatically before copying.) Press ENTER.

5. If your target diskette has not been formatted before, the screen will display a Formatting . . . message before it copies. After it has formatted and copied, it will repeat the message it gave you in step 4:

   ```
   Insert SOURCE Diskette in Drive A :
   Press any key when ready . . .
   ```

   Remove the target diskette from the disk drive and insert the source diskette again. Press ENTER.

6. After another Copying . . . message, the screen will repeat the message from step 5:

   ```
   Insert TARGET Diskette in Drive A :
   ```

```
Press any key when ready . . .
```

Again, remove the source diskette from the disk drive and insert the target diskette. Press ENTER.

7. This is the last stage of the procedure. When the screen displays the message

```
Copy another diskette (Y/N)?
```

the procedure is over; the target diskette has been made into a duplicate of the source diskette.

8. If you want to make another copy of the source diskette, type in Y. The screen will repeat the message

```
Insert SOURCE Diskette in Drive A :
Press any key when ready . . .
```

You can repeat this procedure as many times as necessary and make as many copies of your original diskettes as you need.

Diskcopy with Two Disk Drives

Copying on an IBM PC or IBM compatible Tandy with two disk drives is an even easier procedure, because it doesn't require alternately removing and inserting the source and target diskettes. Follow the directions for steps 1 and 2 for a computer with one disk drive, then type in Diskcopy A: B: at step 3 and press ENTER. The screen will display this message:

```
Insert SOURCE Diskette in Drive A :
Insert TARGET Diskette in Drive B :
Press any key when ready . . .
```

Remove the DOS diskette, insert the source and target diskettes into the proper disk drives and press any key on the typewriter keyboard. The screen will display a copying . . . message while it copies the source diskette and a formatting . . . message if the target diskette hasn't already been formatted. When the screen displays the message

```
Copy another diskette (Y/N)?
```

the procedure is over; the target diskette has been made into a duplicate of the source diskette. If you want to make another copy of the source diskette, type in Y and repeat the procedure.

Caring for Your Diskettes

Your computer diskettes will provide years of dependable service if you and your students handle them properly by following a few simple procedures.

1. Never handle a diskette unnecessarily. When it is necessary to touch a diskette, hold it by the corner near the label, and touch as little of its surface as possible. Under no circumstances should you ever touch the interior magnetic recording surface, either through the center of the diskette or any other opening in the diskette cover.

2. Never bend or fold a diskette or allow pressure to compress it's edges.

3. Whenever possible, write out the diskette label before affixing it to the diskette. If it is necessary to write on the label after it has been affixed to the diskette, always use a felt tipped pen or marker. Never write on the diskette with a pencil or ball point pen.

4. Never attach anything to a diskette with a paper clip of any kind.

5. When a diskette is not in use, always return it to its paper envelope. Store it in a cool, safe place, away from direct sunlight, excessive heat, moisture, dust, and dirt of any kind.

6. Computer diskettes are magnetic, and any contact with other sources of magnetism can destroy the programs and files that are stored on them. Keep your diskettes away from magnets of any kind, no matter how harmless they seem to be. Magnetic desktop paper clip holders (a principal source of trouble because they aren't obvious), magnetic children's toys and so forth can damage your diskettes no matter how harmless they appear to be. In addition, many common electric and electronic appliances are sources of magnetism. Televisions, radios, electric lights, and even the screen of your computer monitor produce minute amounts of magnetism which can cause diskette damage. Store your diskettes away from these devices when they are not in use, and do not allow your diskettes to come into contact with them when you are using them.

7. Never attempt to clean a diskette with cloth or fluid.

8. Always write protect your important diskettes by covering the notch in the left side with tape. This will keep you from accidentally erasing or overwriting an existing program or file.

9. Finally, accidents that ruin or erase diskettes are bound to happen. Learn how to use the diskcopy and copy commands on your DOS, and, as a precaution, always make backup copies of any diskettes you would find difficult or impossible to replace.

For More Help...

The Office of Technology maintains a Technical Assistance Center (TAC) in each of the five boroughs. These centers are equipped with a wide variety of computers, software, and, most important, experienced advisors to help you use the computers in your school more effectively and to answer any questions about computer education you may have. All New York City Public School teachers are welcome to make use of TAC facilities, either by telephone or in person, at any time during the year. TACs are normally open from 9 A.M. to 5 P.M. during the school year and through all school vacations, including the summer, but daily hours can vary. Call first.

Bronx TAC
1000 Teller Avenue
Bronx, N.Y. 10456
(212) 588-0279

Brooklyn TAC
3000 Avenue X
Brooklyn, N.Y. 11235
(718) 769-2860

Manhattan TAC
134 West 122 Street
New York, N.Y. 10027
(212) 662-0122

Queens TAC
167-01 Gothic Drive
Jamaica, N.Y. 11432
(718) 658-0491

Staten Island TAC
1200 Manor Road
Staten Island, N.Y. 10314
(718) 494-5042

List of Software Used in This Text

This list contains all of the software mentioned in this text. The New York City Board of Education in no way recommends any piece of included software. It is the intent of this book to suggest different ways that software can be used to enhance the instructional process and not to recommend any specific software package. It is required that one copy of any piece of software which is used be purchased for each machine in the classroom.

As with any classroom material, it is recommended that software be tested before it is used with students.

Software Title	Software Mfr.	ISBN no.
Advanced Genetics	EME	923820582
Arrakis Advantage: Biology - Volume I	Prentice-Hall	078465052
Biofeedback Microlab	HRM	914133926
Biology Graphics Review - Protozoans	Micro Learningware	896866890
Cell Growth and Mitosis	CCM	903570017
Chemicals of Life II	IBM	904317861
Chemicals of Life III	IBM	904409861
Classifying Animals With Backbones	D.C. Heath	669089834
Classifying Animals Without Backbones	D.C. Heath	669115681
Crossword Magic	Mindscape	870855557
Cytology and Histology I	IBM	904407861
Dicross: Dihybrid Cross	DEE	923727175
Digestive: The Disappearing Dinner	Marshware	602570174
DNA - The Master Molecule	EME	923820701
The Environment II - Cycles and Interfaces	IBM	904413861
Enzyme	DEE	923727299
Experiments in Human Physiology	HRM	914133128
Exploring the Amazing Food Factory, the Leaf	Thoroughbred	903570033
Food Chains and Webs	Prentice-Hall	13703752X
The Human Body: An Overview	BrainBank Inc.	917277023
Human Circulatory System	EME	923820620
Human Life Processes I	IBM	*
Human Life Processes II	IBM	904411861
Human Systems: Series II (The Nervous System)	Focus Media	55141129
Leaf: Structure and Function	CCM	90357005X
Leaf: Structure and Physiology	IBM	904388867
Life Zones in the Ocean	Prentice-Hall	137047274
Light, Plants and Photosynthesis	IBM	904319861
Mendelian Genetics	IBM	904408861
The Microscope Simulator	Focus Media Inc.	923727523
Monocross: A Monohybrid Cross	DEE	923727523
NICHE - Ecological Game Simulation	DEE	923727604
Passive Transport	CCM	922928045
Passive Transport: Diffusion and Osmosis	IBM	904320863
Photosynthesis and Light	CCM	903570033
Plants: Growth and Specialization	IBM	90432186X
Regulation and Homeostasis: Systems in Balance	IBM	904410861
Structure of Matter	CCM	92292810X
Taxonomy - Classification and Organization	IBM	904416860
Terrestrial Biomes	Prentice-Hall	137081081
Water Pollution	EME	604570074

* ISBN number not available